PROBLEMAS RESUELTOS DE
ANALISIS DE ESTRUCTURAS POR EL METODO DE LOS NUDOS

Problema resuelto Pág. 246 Estática BEDFORD
Problema 6.1 Estática BEDFORD edic 4
Problema 6.2 Estática BEDFORD edic 4
Problema 6.4 Estática BEDFORD edic 5
Problema 6.13 Estática BEDFORD edic 4
Problema 6.14 Estática BEDFORD edic 4
Problema 6.1 BEER– Johnston edic 6
Problema 6.2 BEER– Johnston edic 6
Problema 6.3 BEER– Johnston edic 6
Problema 6.4 BEER– Johnston edic 6
Problema 6.1 Estática Hibbeler edic 10
Problema 6.2 Estática Hibbeler edic 10
Problema 6.3 Estática Hibbeler edic 10
Problema 6.4 Estática Hibbeler edic 10
Problema c-34 estática Hibbeler edic 10
Problema C-35 estática Hibbeler edic 10
Problema 6.8 estática Hibbeler edic 10
Problema resuelto Pag. 145 Estática Meriam
Problema 4.1 Estática Meriam edición tres
Problema 4.1 Estática Meriam edición cinco
Problema 4.3 Estática Meriam edición tres
Problema 4.3 Estática Meriam edición cinco
Problema 4.4 Estática Meriam edición tres
Problema 4.4 Estática Meriam edición cinco
Problema 4.5 Estática Meriam edición tres
Problema 4.7 Estática Meriam edición tres

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Método de las juntas o nudos (PROBLEMA RESUELTO PAG. 246 ESTATICA BEDFORD)
El método de las juntas implica dibujar diagramas de cuerpo libre de las juntas de una armadura, una por una, y usar las ecuaciones de equilibrio para determinar las fuerzas axiales en las barras. Por lo general, antes debemos dibujar un diagrama de toda la armadura (es decir, tratar la armadura como un solo cuerpo) y calcular las reacciones en sus soportes. Por ejemplo, la armadura WARREN de la figura 6.6(a) tiene barras de 2 metros de longitud y soporta cargas en B y D. En la figura 6.6(b) dibujamos su diagrama de cuerpo libre. De las ecuaciones de equilibrio.

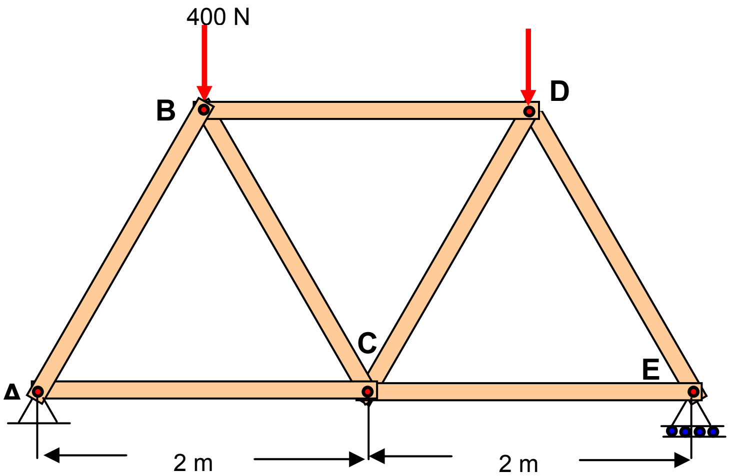


Fig. 6. 6(a) Armadura **WARREN** soportando dos cargas

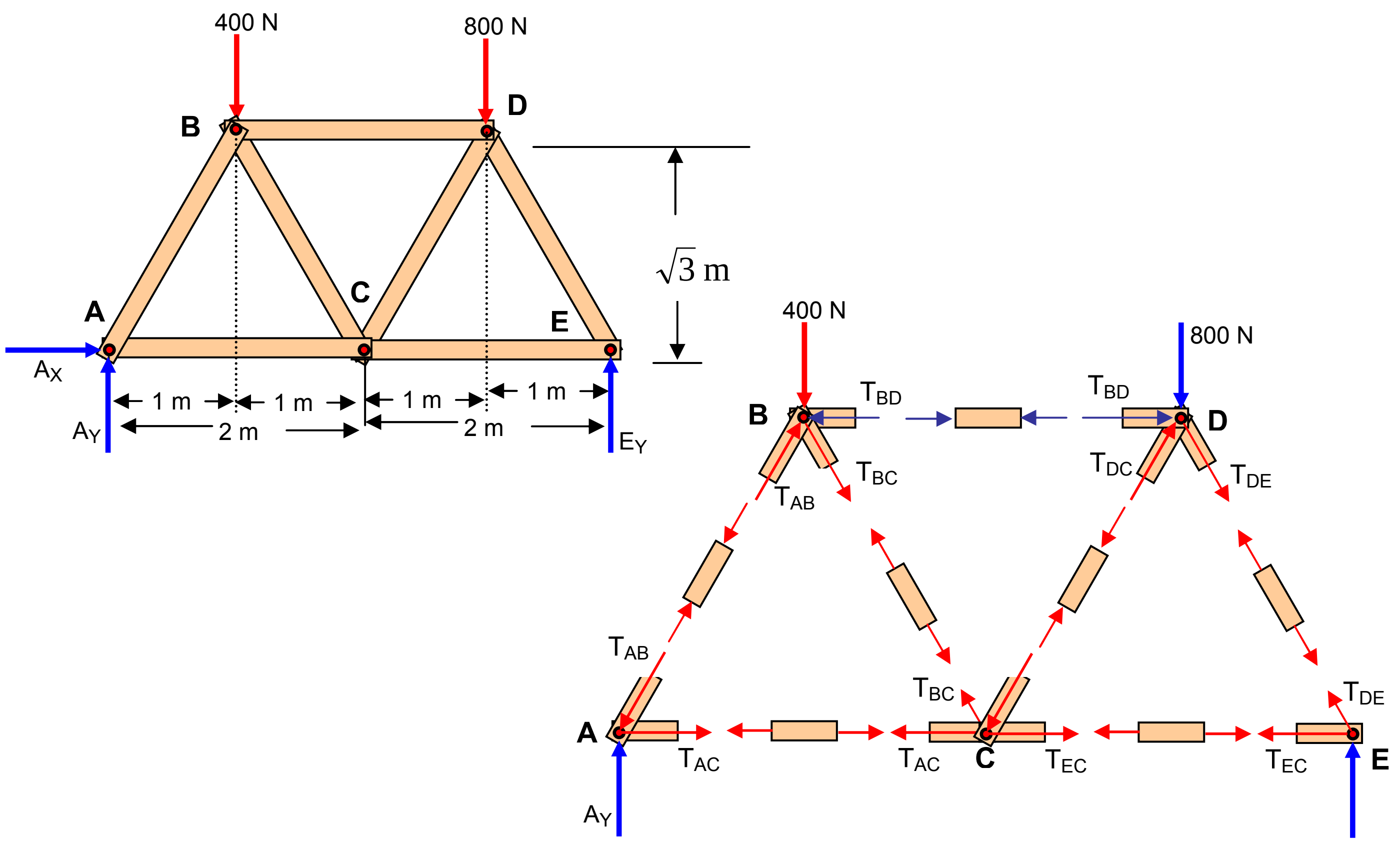


Fig. 6. 6(b) Diagrama de cuerpo libre de la armadura

$\Sigma M_A = 0$

$\curvearrowleft +$ $\quad - 400\ (1)\ - 800\ (1+1+1) + E_Y\ (1+1+1+1) = 0$

$- 400\ - 800\ (3) + E_Y\ (4) = 0$

$- 400 - 2400 + 4\ E_Y = 0$

$- 2800 + 4\ E_Y = 0$

$4\ E_Y = 2800$

$$E_Y = \frac{2800}{4} = 700\ \text{N}$$

E_Y = 700 N

$\sum F_X = 0 \quad A_X = 0$

$\sum F_Y = 0$

$A_Y + E_Y - 400 - 800 = 0$

$\Sigma M_E = 0$

$\curvearrowleft +$ $\quad - A_Y\ (1+1+1+1) + 400\ (1+1+1)\ + 800\ (1) = 0$

$- A_Y\ (4) + 400\ (3) + 800 = 0$

$- 4\ A_Y + 1200 + 800 = 0$

$4\ A_Y = 2000$

$$A_Y = \frac{2000}{4} = 500\ \text{N}$$

A_Y = 500 N

NUDO A

El siguiente paso es elegir una junta y dibujar su diagrama de cuerpo libre. En la figura 6.7(a) aislamos la junta A cortando las barras AB y AC. Los términos T_{AB} y T_{AC} son las fuerzas axiales en las barras AB y AC respectivamente. Aunque las direcciones de las flechas que representan las fuerzas axiales desconocidas se pueden escoger arbitrariamente, observe que las hemos elegido de manera que una barra estará a tensión, si obtenemos un valor positivo para la fuerza axial. Pensamos que escoger consistentemente las direcciones de esta manera ayudara a evitar errores.

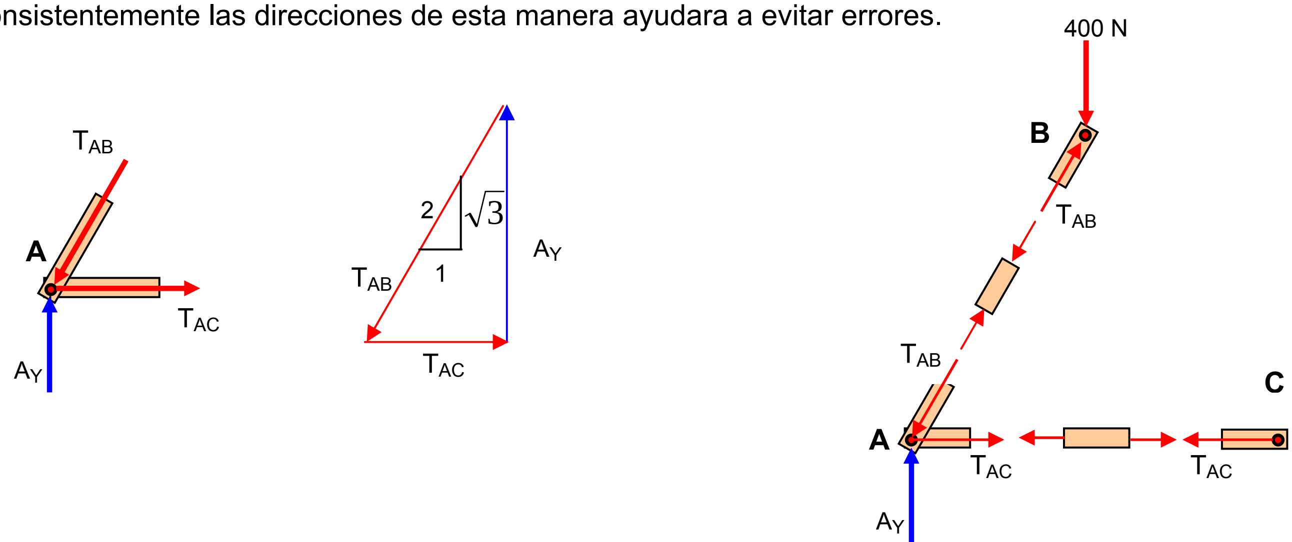


Figura 6.7(a) Obtención del diagrama de cuerpo libre de la junta A.

Las ecuaciones de equilibrio para la junta A son:

$$\frac{T_{AB}}{2} = \frac{T_{AC}}{1} = \frac{A_Y}{\sqrt{3}}$$

Hallar T_{AC}

$$\frac{T_{AB}}{2} = \frac{T_{AC}}{1}$$

$$T_{AC} = \frac{T_{AB}}{2}$$

T_{AB} = 577,35 Newton

$$T_{AC} = \frac{577,35}{2} = 288,67 \text{ N}$$

T_{AC} = 288,67 Newton (Tension)

Hallar T_{AB}

$$\frac{T_{AB}}{2} = \frac{A_Y}{\sqrt{3}}$$

A_Y = 500 N

$$\frac{T_{AB}}{2} = \frac{500}{\sqrt{3}} = 288,67$$

$$T_{AB} = 2(288,67) = 577,35 \text{ N}$$

T_{AB} = 577,35 Newton(compresión)

NUDO B

Luego obtenemos un diagrama de la junta B cortando las barras AB, BC y BD (Fig. 6.8 a). De las ecuaciones de equilibrio para la junta B.

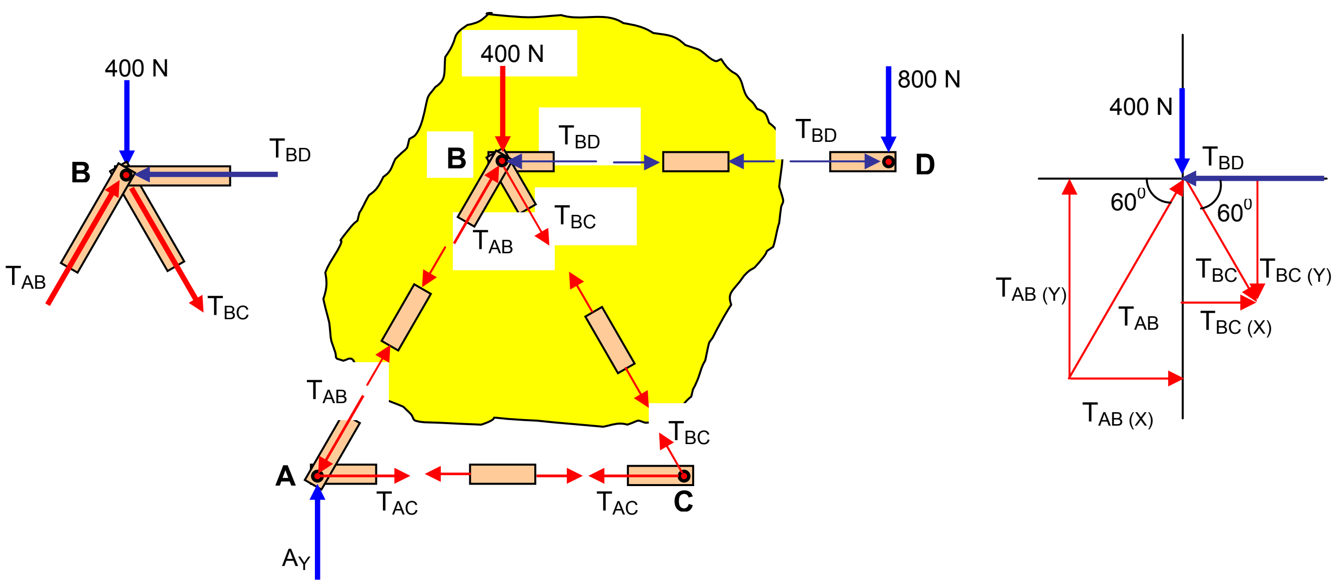


Figura 6.8(a) Obtención del diagrama de cuerpo libre de la junta B.

$$\text{sen } 60 = \frac{T_{AB(Y)}}{T_{AB}}$$

$T_{AB\,(Y)}$ = T_{AB} sen 60

$$T_{AB(Y)} = T_{AB}\left(\frac{\sqrt{3}}{2}\right)$$

Para abreviar los cálculos

$$\text{sen } 60 = \frac{\sqrt{3}}{2} \qquad \cos 60 = \frac{1}{2}$$

$$T_{AB(Y)} = \left(\frac{\sqrt{3}}{2}\right) T_{AB}$$

T_{AB} = 577,35 Newton

$$T_{AB(Y)} = \left(\frac{\sqrt{3}}{2}\right)(577{,}35) = 500 \text{ N}$$

$T_{AB\,(Y)}$ = 500 N

$$\cos 60 = \frac{T_{AB(X)}}{T_{AB}}$$

$T_{AB\,(X)}$ = T_{AB} cos 60

$$T_{AB(X)} = T_{AB}\left(\frac{1}{2}\right)$$

$$T_{AB(X)} = \left(\frac{1}{2}\right) T_{AB}$$

T_{AB} = 577,35 Newton

$$T_{AB(X)} = \frac{1}{2}(577{,}35) = 288{,}67 \text{ N}$$

$T_{AB\,(X)}$ = 288,67 N

$$\text{sen } 60 = \frac{T_{BC(Y)}}{T_{BC}}$$

$T_{BC\,(Y)}$ = T_{BC} sen 60

$$T_{BC(Y)} = T_{BC}\left(\frac{\sqrt{3}}{2}\right)$$

$$T_{BC(Y)} = \left(\frac{\sqrt{3}}{2}\right) T_{BC}$$

$$\cos 60 = \frac{T_{BC(X)}}{T_{BC}}$$

$T_{BC\,(X)}$ = T_{BC} cos 60

$$T_{BC(X)} = T_{BC}\left(\frac{1}{2}\right)$$

$$T_{BC(X)} = \left(\frac{1}{2}\right) T_{BC}$$

$\sum F_Y = 0$

$-400 + T_{AB\,(Y)} - T_{BC\,(Y)} = 0$

$T_{AB\,(Y)}$ = 500 N

$-400 + 500 - T_{BC\,(Y)} = 0$

$100 - T_{BC\,(Y)} = 0$

$100 = T_{BC\,(Y)}$

$$T_{BC(Y)} = \left(\frac{\sqrt{3}}{2}\right) T_{BC}$$

$100 = T_{BC\,(Y)}$

$$100 = \left(\frac{\sqrt{3}}{2}\right) T_{BC}$$

$$T_{BC} = \left(\frac{2}{\sqrt{3}}\right) 100 = \frac{200}{\sqrt{3}} = 115{,}47 \text{ N}$$

T_{BC} = 115,47 N (compresión)

$\sum F_X = 0$

$-T_{BD} + T_{AB\,(X)} + T_{BC\,(X)} = 0$

$T_{AB\,(X)}$ = 288,67 N

$T_{BC\,(X)}$ = 57,73 Newton

$-T_{BD}$ + 288,67 + 57,73 = 0

$-T_{BD}$ + 346,4 = 0

T_{BD} = 346,4 Newton (compresión)

Se halla $T_{BC\,(X)}$

$$T_{BC(X)} = \left(\frac{1}{2}\right) T_{BC}$$

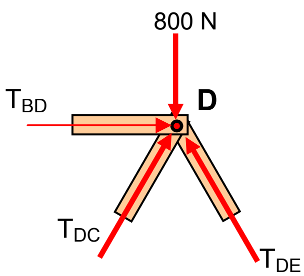
T_{BC} = 115,47 N

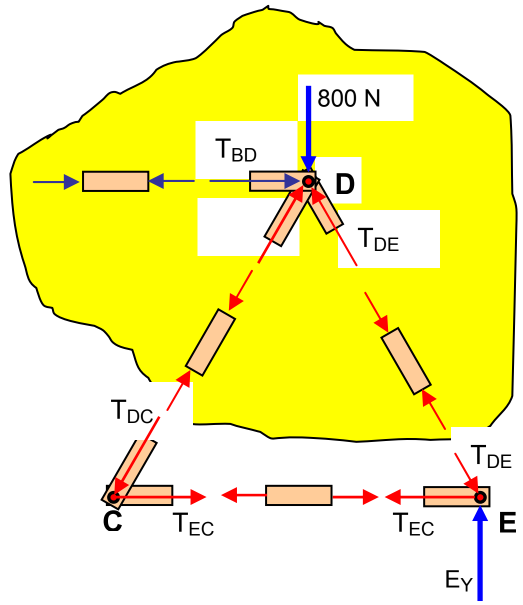
$$T_{BC(X)} = \left(\frac{1}{2}\right)(115{,}47) = 57{,}73 \text{ N}$$

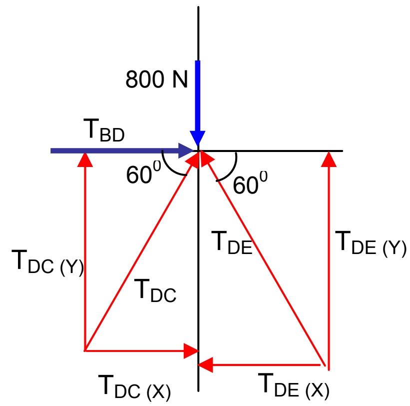
$T_{BC\,(X)}$ = 57,73 Newton

NUDO D

Luego obtenemos un diagrama de la junta D cortando las barras BD, DC y DE . De las ecuaciones de equilibrio para la junta D.







Para abreviar los cálculos

$$\text{sen } 60 = \frac{\sqrt{3}}{2} \qquad \cos 60 = \frac{1}{2}$$

$$\text{sen } 60 = \frac{T_{DC(Y)}}{T_{DC}}$$

$T_{DC\,(Y)} = T_{DC}$ sen 60

$$T_{DC(Y)} = T_{DC}\left(\frac{\sqrt{3}}{2}\right)$$

$$T_{DC(Y)} = \left(\frac{\sqrt{3}}{2}\right) T_{DC}$$

$$\cos 60 = \frac{T_{DC(X)}}{T_{DC}}$$

$T_{DC\,(X)} = T_{DC}$ cos 60

$$T_{DC(X)} = T_{DC}\left(\frac{1}{2}\right)$$

$$T_{DC(Y)} = \left(\frac{\sqrt{3}}{2}\right) T_{DC}$$

$$\text{sen } 60 = \frac{T_{DE(Y)}}{T_{DE}}$$

$T_{DE\,(Y)} = T_{DE}$ sen 60

$$T_{DE(Y)} = T_{DE}\left(\frac{\sqrt{3}}{2}\right)$$

$$T_{DE(Y)} = \left(\frac{\sqrt{3}}{2}\right) T_{DE}$$

$$\cos 60 = \frac{T_{DE(X)}}{T_{DE}}$$

$T_{DE\,(X)} = T_{DE}$ cos 60

$$T_{DE(X)} = T_{DE}\left(\frac{1}{2}\right)$$

$$T_{DE(X)} = \left(\frac{1}{2}\right) T_{DE}$$

$\sum F_X = 0$

$T_{BD} - T_{DE\,(X)} + T_{DC\,(X)} = 0$

T_{BD} = 346,4 Newton (compresión)

346,4 - $T_{DE\,(X)} + T_{DC\,(X)} = 0$

$T_{DE\,(X)} - T_{DC\,(X)} = 346,4$ ecuación 1

Pero:

$$T_{DE}(X) = \left(\frac{1}{2}\right) T_{DE}$$

$$T_{DC}(X) = T_{DC}\left(\frac{1}{2}\right)$$

Reemplazando en la ecuación 1

$$\left(\frac{1}{2}\right) T_{DE} - \left(\frac{1}{2}\right) T_{DC} = 346,4 \quad \textbf{ecuación 3}$$

$\sum F_Y = 0$

$- 800 + T_{DE\,(Y)} + T_{DC\,(Y)} = 0$

$T_{DE\,(Y)} + T_{DC\,(Y)} = 800$ ecuación 2

Pero:

$$T_{DE}(Y) = \left(\frac{\sqrt{3}}{2}\right) T_{DE}$$

$$T_{DC}(Y) = \left(\frac{\sqrt{3}}{2}\right) T_{DC}$$

Reemplazando en la ecuación 2

$$\left(\frac{\sqrt{3}}{2}\right) T_{DE} + \left(\frac{\sqrt{3}}{2}\right) T_{DC} = 800 \quad \textbf{ecuación 4}$$

resolver ecuación 3 y ecuación 4

$$\left(\frac{1}{2}\right) T_{DE} - \left(\frac{1}{2}\right) T_{DC} = 346,4 \text{ multiplicar por } \left[\sqrt{3}\right]$$

$$\left(\frac{\sqrt{3}}{2}\right) T_{DE} + \left(\frac{\sqrt{3}}{2}\right) T_{DC} = 800$$

$$\left(\frac{\sqrt{3}}{2}\right) T_{DE} - \cancel{\left(\frac{\sqrt{3}}{2}\right) T_{DC}} = 346,4 \left[\sqrt{3}\right] = 600$$

$$\left(\frac{\sqrt{3}}{2}\right) T_{DE} + \cancel{\left(\frac{\sqrt{3}}{2}\right)} T_{DC} = 800$$

$$\left(\frac{\sqrt{3}}{2}\right) T_{DE} + \left(\frac{\sqrt{3}}{2}\right) T_{DE} = 600 + 800 = 1400$$

$$2\left(\frac{\sqrt{3}}{2}\right) T_{DE} = 1400$$

$$\sqrt{3}\, T_{DE} = 1400$$

$$T_{DE} = \frac{1400}{\sqrt{3}} = 808,29 \text{ N}$$

T_{DE} = 808,29 Newton (compresión)

Reemplazando en la ecuación 4, se halla T_{DC}

$$\left(\frac{\sqrt{3}}{2}\right) T_{DE} + \left(\frac{\sqrt{3}}{2}\right) T_{DC} = 800 \quad \textbf{ecuación 4}$$

$$\left(\frac{\sqrt{3}}{2}\right)(808{,}29) + \left(\frac{\sqrt{3}}{2}\right) T_{DC} = 800$$

$$700 + \left(\frac{\sqrt{3}}{2}\right) T_{DC} = 800$$

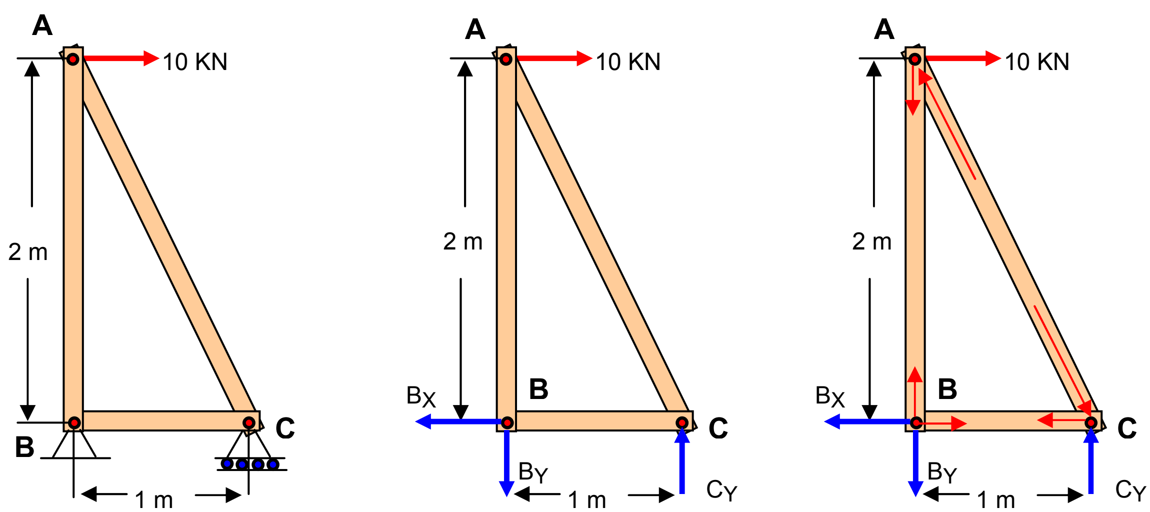
$$\left(\frac{\sqrt{3}}{2}\right) T_{DC} = 800 - 700 = 100$$

$$T_{DC} = 100\left(\frac{2}{\sqrt{3}}\right) = \frac{200}{\sqrt{3}} = 115{,}47 \text{ N}$$

T_{DC} = 115,47 Newton (Tensión)

Problema 6.1 ESTATICA BEDFORD edic 4

Determine the axial forces in the members of the truss and indicate whether they are in tension (T) or compression (C)



$\Sigma M_C = 0$

$+ \quad B_Y (1) - 10 (2) = 0$

$B_Y (1) = 10 (2)$

B_Y = 20 KN

$\sum F_X = 0$

$10 - B_X = 0$

B_X = 10 KN

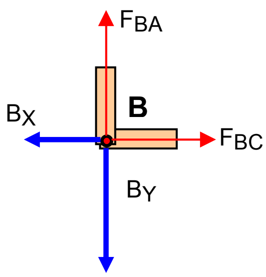
$\sum F_Y = 0$

$C_Y - B_Y = 0$

$C_Y = B_Y$ Pero: $B_Y = 20$ KN

C_Y = 20 KN

NUDO B



$\sum F_X = 0$

$F_{BC} - B_X = 0$

$F_{BC} = B_X$

pero: $B_X = 10$ KN

F_{BC} = 10 KN (tensión)

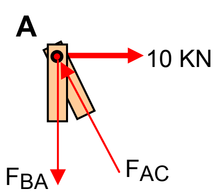
$\sum F_Y = 0$

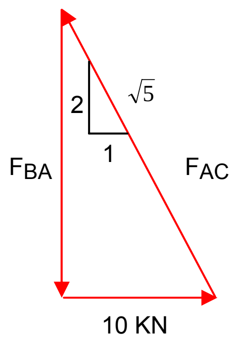
$F_{BA} - B_Y = 0$
$F_{BA} = B_Y$

pero: $B_Y = 20$ KN

F_{BA} = 20 KN (tensión)

NUDO A





$$\frac{F_{BA}}{2} = \frac{10}{1} = \frac{F_{AC}}{\sqrt{5}}$$

Hallamos F_{AC}

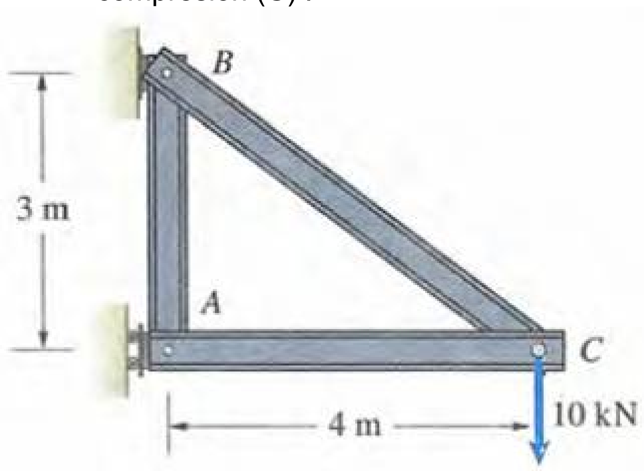
$$\frac{10}{1} = \frac{F_{AC}}{\sqrt{5}}$$

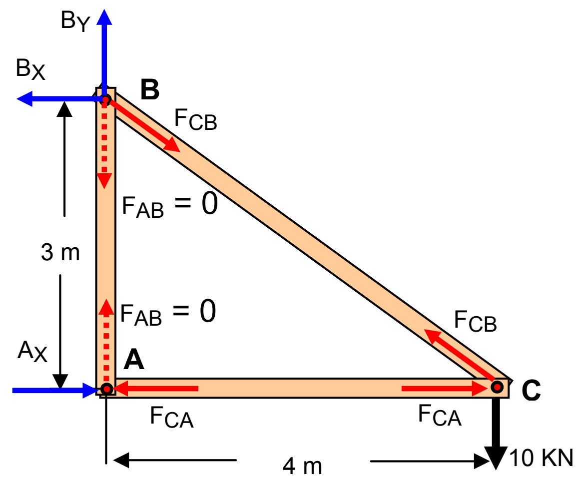
$$F_{AC} = 10\left(\sqrt{5}\right) = 22{,}36KN$$

F_{AC} = 22,36 KN (compresión)

Problema 6.2 ESTATICA BEDFORD edic 4
La armadura mostrada soporta una carga de 10 kN en C.

a) Dibuje el diagrama de cuerpo libre de toda la armadura y determine las reacciones en sus soportes
b) Determine las fuerzas axiales en las barras. Indique si se encuentran a tensión (T) o a compresión (C) .





$\Sigma M_B = 0$

\+ $A_X (3) - 10 (4) = 0$

$A_X (3) = 10 (4)$

$3 A_X = 40$

$$A_X = \frac{40}{3} = 13{,}33 KN$$

A_X = 13,33 KN

$\sum F_Y = 0$

$B_Y - 10 = 0$

B_Y = 10 KN

$\Sigma M_A = 0$

\+ $B_X (3) - 10 (4) = 0$

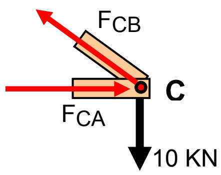
$B_X (3) = 10 (4)$

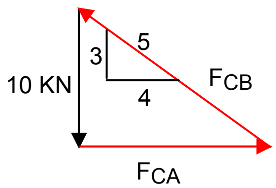
$3 B_X = 40$

$$B_X = \frac{40}{3} = 13{,}33 KN$$

B_X = 13,33 KN

NUDO C





$$\frac{F_{CB}}{5} = \frac{F_{CA}}{4} = \frac{10}{3}$$

Hallar F_{CB}

$$\frac{F_{CB}}{5} = \frac{10}{3}$$

$$F_{CB} = \frac{(5)10}{3} = 16{,}66 \text{ KN}$$

F_{CB} = 16,66 kN (Tensión)

Hallar F_{CA}

$$\frac{F_{CA}}{4} = \frac{10}{3}$$

$$F_{CA} = \frac{(4)10}{3} = 13{,}33 \text{ KN}$$

F_{CA} = 13,33 kN (compresión)

NUDO A

$\sum F_Y = 0$ **$F_{AB} = 0$**

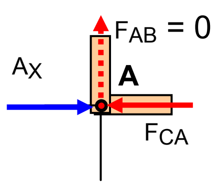
$\sum F_X = 0$

$A_X - F_{CA} = 0$

$A_X = F_{CA}$

Pero: F_{CA} = 13,33 kN

$A_X = F_{CA}$ =13,33 kN



A_X = 13,33 KN

B_Y = 10 KN

B_X = 13,33 KN

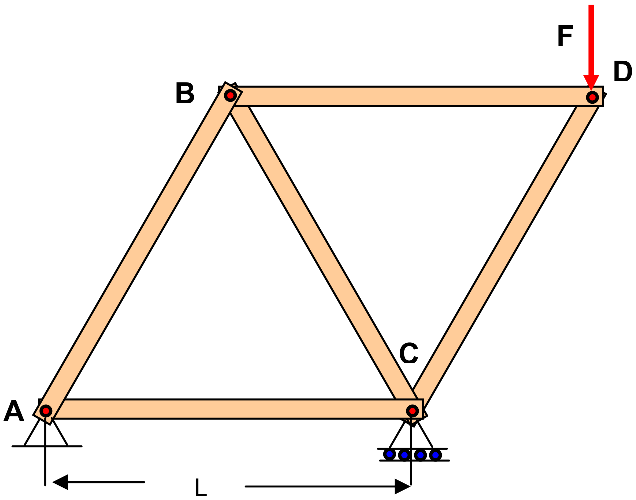
F_{CB} = 16,66 kN (Tensión)

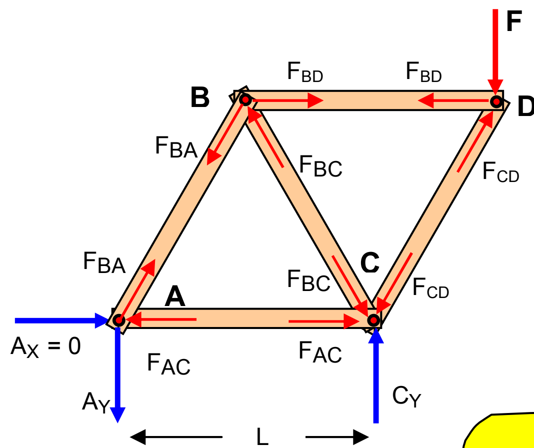
F_{CA} = 13,33 kN (compresión)

F_{AB} = 0

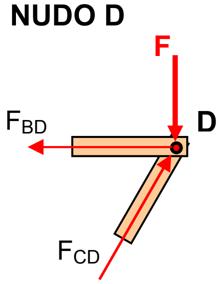
Problema 6.4 ESTATICA BEDFORD edic 5

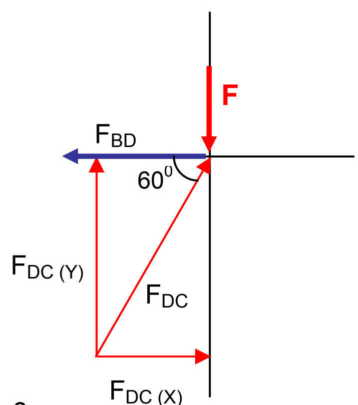
The members of the truss are all of lenght L. Determine the axial forces in the members and indicate whether they are in tension (T) or compression (C)

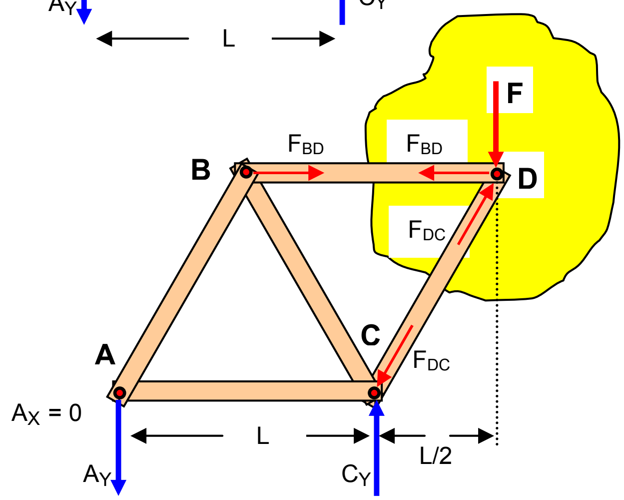




NUDO D







$\Sigma M_C = 0$

$+ \quad A_Y (L) – F (L/2) = 0$

$A_Y (\cancel{L}) = F (\cancel{L}/2)$

$A_Y = ½ F$

$\Sigma M_A = 0$

$+ \quad C_Y (L) – F (L + L/2) = 0$

$C_Y (L) - F (3/2\ L) = 0$

$C_Y (\cancel{L}) = F (3/2\ \cancel{L})$

$C_Y = F (3/2)$

$C_Y = 3/2\ F$

$$\text{sen } 60 = \frac{F_{DC(Y)}}{F_{DC}}$$

$$\cos 60 = \frac{F_{DC(X)}}{F_{DC}}$$

$F_{DC\ (X)} = F_{DC} \cos 60$

$$F_{DC(X)} = F_{DC}\left(\frac{1}{2}\right)$$

Para abreviar los cálculos

$$\text{sen } 60 = \frac{\sqrt{3}}{2} \qquad \cos 60 = \frac{1}{2}$$

$F_{DC\,(Y)} = F_{DC}$ sen 60

$$F_{DC(Y)} = F_{DC}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{DC(Y)} = \left(\frac{\sqrt{3}}{2}\right)F_{DC}$$

$\sum F_Y = 0$

$- F + F_{DC\,(Y)} = 0$

$F = F_{DC\,(Y)}$

Pero:
$F_{DC\,(Y)} = F_{DC}$ sen 60
$F = F_{DC}$ sen 60

DESPEJANDO F_{DC}

$$F_{DC} = \frac{1}{\text{sen } 60}(F) = 1{,}154\ F$$

F_{DC} = 1,154 F (Compresion)

$\sum F_X = 0$

$- F_{BD} + F_{DC\,(X)} = 0$

$F_{BD} = F_{DC\,(X)}$

Pero:
$F_{DC\,(X)} = F_{DC}$ cos 60

F_{BD} = F_{DC} cos 60

Pero: F_{DC} = 1,154 F

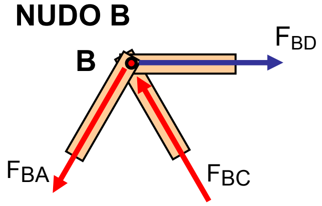
F_{BD} = (1,154 F) cos 60
F_{BD} = 0,577 F (tensión)

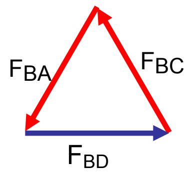
$\sum F_X = 0 \quad A_X = 0$

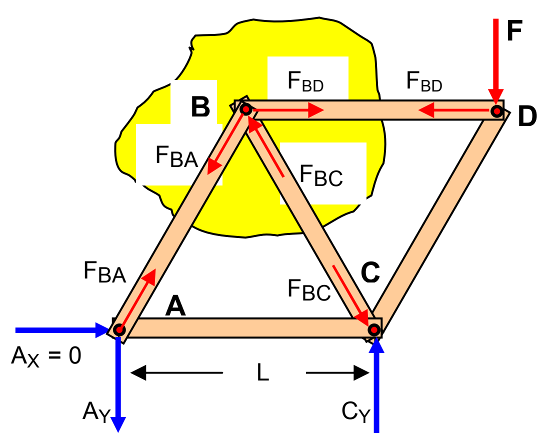
$\sum F_Y = 0$

$A_Y + E_Y – 400 - 800 = 0$

NUDO B







$$\text{sen } 60 = \frac{F_{BA(Y)}}{T_{AB}}$$

$F_{BA\ (Y)}$ = T_{BA} sen 60

$$F_{BA(Y)} = F_{BA}\left(\frac{\sqrt{3}}{2}\right)$$

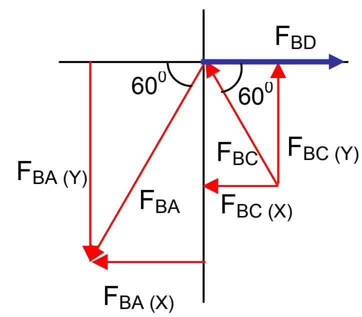
$$F_{BA(Y)} = \left(\frac{\sqrt{3}}{2}\right)F_{BA}$$

$$\cos 60 = \frac{F_{BA(X)}}{F_{BA}}$$

$F_{BA\ (X)}$ = F_{BA} cos 60

$$F_{BA(X)} = F_{BA}\left(\frac{1}{2}\right)$$

$$F_{BA(X)} = \left(\frac{1}{2}\right)F_{BA}$$



$$\text{sen } 60 = \frac{F_{BC(Y)}}{F_{BC}}$$

$F_{BC\ (Y)}$ = T_{BC} sen 60

$$F_{BC(Y)} = F_{BC}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{BC(Y)} = \left(\frac{\sqrt{3}}{2}\right)F_{BC}$$

$$\cos 60 = \frac{F_{BC(x)}}{F_{BC}}$$

$F_{BC\ (X)}$ = F_{BC} cos 60

$$F_{BC}(X) = F_{BC}\left(\frac{1}{2}\right)$$

$\sum F_X = 0$

F_{BD} - $F_{BC\ (X)}$ - $F_{BA\ (X)}$ = 0

$$F_{BD} - F_{BC(X)} - F_{BA}(X) = 0$$

$$F_{BC(X)} + F_{BA}(X) = F_{BD}$$

Para abreviar los cálculos

$$\text{sen } 60 = \frac{\sqrt{3}}{2} \qquad \cos 60 = \frac{1}{2}$$

PERO:

F_{BD} = 0,577 F

$$F_{BC(X)} + F_{BA}(X) = 0{,}577\ F$$

$$\left(\frac{1}{2}\right)F_{BC} + \left(\frac{1}{2}\right)F_{BA} = 0{,}577\ F$$ **(ECUACIÓN 1)**

$\sum F_Y = 0$

$F_{BC\ (Y)}$ - $F_{BA\ (Y)}$ = 0

$$\left(\frac{\sqrt{3}}{2}\right)F_{BC} - \left(\frac{\sqrt{3}}{2}\right)F_{BA} = 0$$ **(ECUACIÓN 2)**

resolver ecuación 1 y ecuación 2

$$\left(\frac{1}{2}\right)F_{BC} + \left(\frac{1}{2}\right)F_{BA} = 0{,}577\ F \text{ multiplicar por } \left[\sqrt{3}\right]$$

$$\left(\frac{\sqrt{3}}{2}\right)F_{BC} - \left(\frac{\sqrt{3}}{2}\right)F_{BA} = 0$$

$$\left(\frac{\sqrt{3}}{2}\right)F_{BC} + \cancel{\left(\frac{\sqrt{3}}{2}\right)F_{BA}} = \left(\sqrt{3}\right)\left(0{,}577\ F\right)$$

$$\left(\frac{\sqrt{3}}{2}\right)F_{BC} - \cancel{\left(\frac{\sqrt{3}}{2}\right)F_{BA}} = 0$$

$$2\left(\frac{\sqrt{3}}{2}\right)F_{BC} = F$$

$$\sqrt{3}\,F_{BC} = F$$

$$F_{BC} = \left(\frac{1}{\sqrt{3}}\right)F$$

F_{BC} = 0,577 F (compresión)

Reemplazando en la ecuación 2

$$\left(\frac{\sqrt{3}}{2}\right)F_{BC} - \left(\frac{\sqrt{3}}{2}\right)F_{BA} = 0 \quad \textbf{(ECUACIÓN 2)}$$

$$\left(\frac{\sqrt{3}}{2}\right)\left(0{,}577\ F\right) - \left(\frac{\sqrt{3}}{2}\right)F_{BA} = 0$$

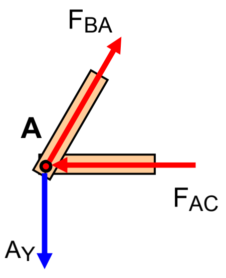
$$\cancel{\left(\frac{\sqrt{3}}{2}\right)}\left(0{,}577\ F\right) = \cancel{\left(\frac{\sqrt{3}}{2}\right)}F_{BA}$$

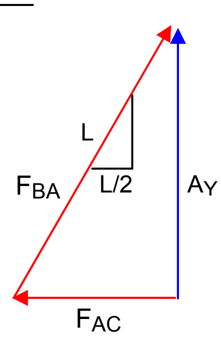
Cancelando terminos semejantes

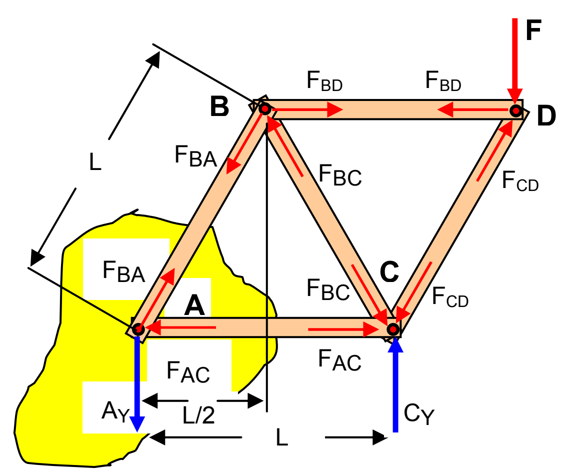
$$\left(0{,}577\ F\right) = F_{BA}$$

F_{BA} = 0,577 F (tensión)

NUDO A







$$\frac{F_{BA}}{L} = \frac{F_{AC}}{L/2}$$

$$\frac{F_{BA}}{\cancel{L}} = \frac{2\,F_{AC}}{\cancel{L}}$$

Cancelando términos semejantes
$F_{BA} = 2\ F_{AC}$

Pero: $F_{BA} = 0{,}577\ F$
$0{,}577\ F = 2\ F_{AC}$

$$F_{AC} = \frac{0{,}577}{2} F$$

F_{AC} = 0,288 F (Compresión)

$A_Y = ½\ F$

$C_Y = 3/2\ F$

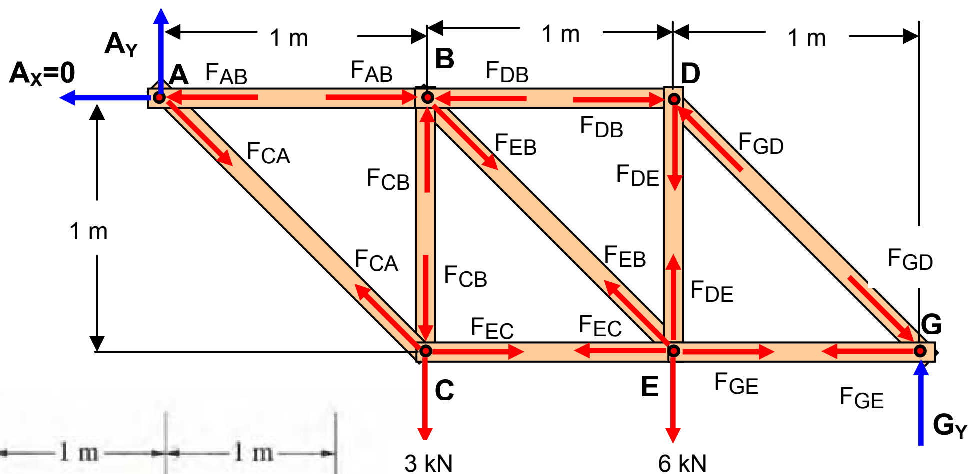
F_{DC} = 1,154 F (Compresion)

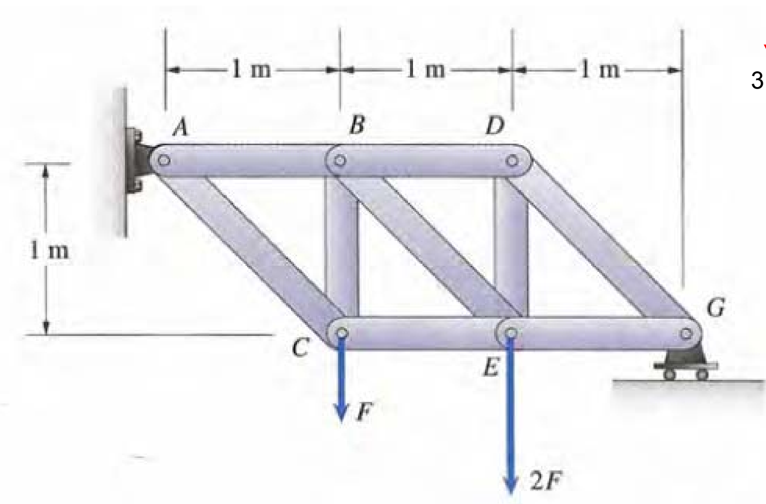
F_{BD} = 0,577 F (tensión)

F_{BC} = 0,577 F (compresión)

F_{BA} = 0,577 F (tensión)

Problema 6.13 bedford edic 4
La armadura recibe cargas en C y E. Si F = 3 KN, cuales son las fuerzas axiales BC y BE?





$\Sigma\ M_G = 0$

$+ \qquad 6\ (1)\ + 3\ (1 + 1) - A_Y\ (1+1+1) = 0$

$6\ (1)\ + 3\ (2) - A_Y\ (3) = 0$

$6\ \ + 6 - 3\ A_Y = 0$

$6\ \ + 6 = \ 3\ A_Y$

$12 = \ 3\ A_Y$

$$A_Y = \frac{12}{3} = 4\,KN$$

A_Y = 4 KN

$\sum F_X = 0 \quad A_X = 0$

$\Sigma M_A = 0$

$+ \quad - 3\ (1)\ - 6\ (1 + 1) + G_Y\ (1+1+1) = 0$

$- 3\ \ - 6\ (2) + G_Y\ (3) = 0$

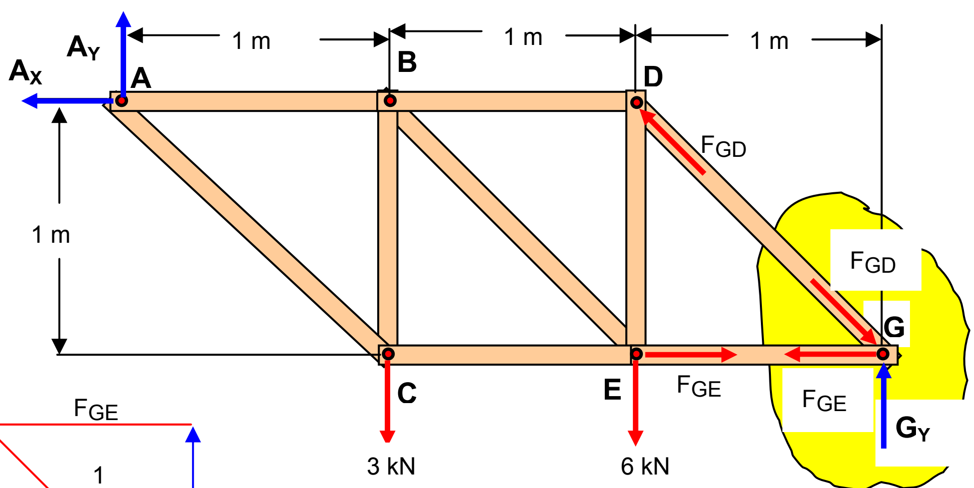
$- 3\ \ - 12 + 3\ G_Y = 0$

$- 15 + 3\ G_Y = 0$

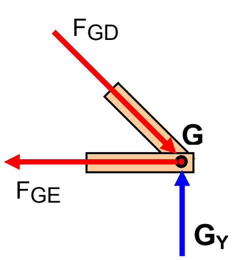
$3\ G_Y = 15$

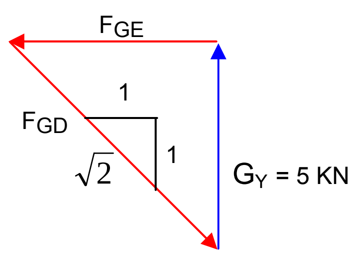
$$G_Y = \frac{15}{3} = 5\,KN$$

G_Y = 5 KN



NUDO G





Las ecuaciones de equilibrio para la junta G son:

$$\frac{F_{GD}}{\sqrt{2}} = \frac{F_{GE}}{1} = \frac{5}{1}$$

Hallar F_{GD}

$$\frac{F_{GD}}{\sqrt{2}} = 5$$

Hallar F_{GE}

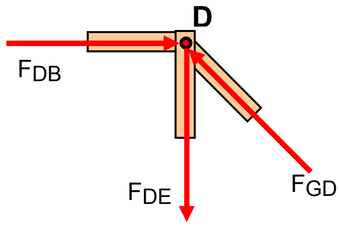
$$\frac{F_{GE}}{1} = \frac{5}{1}$$

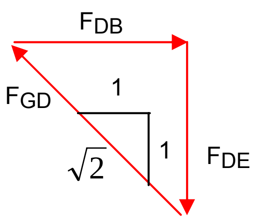
F_{GE} = 5 KN (Tensión)

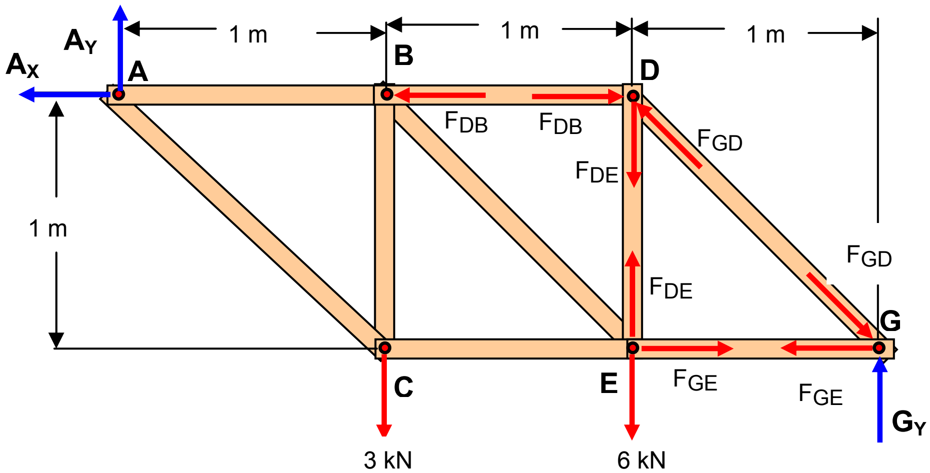
$$F_{GD} = \sqrt{2}\,(5)$$

F_{GD} = 7,071 KN (compresión)

NUDO D







Las ecuaciones de equilibrio para la junta D son:

$$\frac{F_{GD}}{\sqrt{2}} = \frac{F_{DE}}{1} = \frac{F_{DB}}{1}$$

PERO: **F_{GD} = 7,071 KN**

$$\frac{7{,}071}{\sqrt{2}} = \frac{F_{DE}}{1} = \frac{F_{DB}}{1}$$

$$5 = F_{DE} = F_{DB}$$

Hallar F_{DB}

$$5 = F_{DB}$$

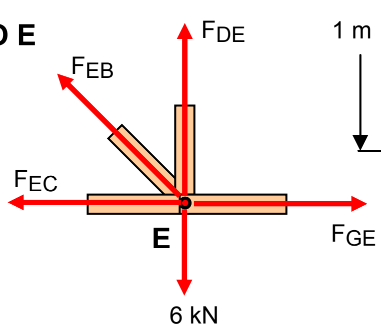
F_{DB} = 5 KN (compresion)

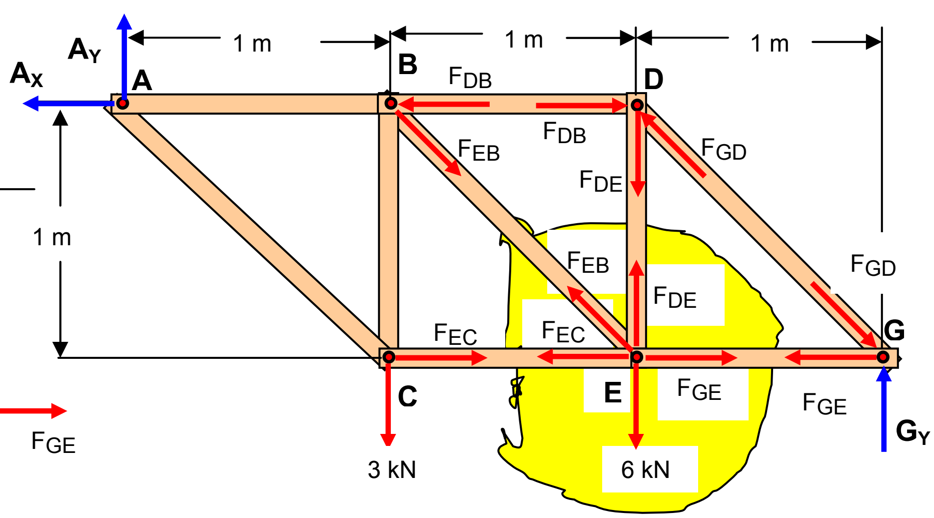
Hallar F_{DE}

$$5 = F_{DE}$$

F_{DE} = 5 KN (TENSION)

NUDO E





$$\text{sen } 45 = \frac{F_{EB(Y)}}{F_{EB}}$$

$F_{EB\,(Y)} = F_{EB}$ sen 45

$$F_{EB(Y)} = F_{EB}\left(\frac{\sqrt{2}}{2}\right)$$

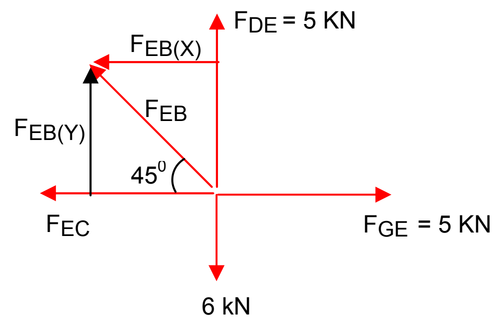
$$F_{EB(Y)} = \left(\frac{\sqrt{2}}{2}\right)F_{EB}$$

$$\cos 45 = \frac{F_{EB(X)}}{F_{EB}}$$

$F_{EB\,(X)} = F_{EB}$ cos 45

$$F_{EB(X)} = F_{EB}\left(\frac{\sqrt{2}}{2}\right)$$

$$F_{EB(X)} = \left(\frac{\sqrt{2}}{2}\right)F_{EB}$$



$\sum F_Y = 0$

$F_{DE} - 6 + F_{EB(Y)} = 0$

PERO: $F_{DE} = 5$ kN

$5 - 6 + F_{EB(Y)} = 0$

$- 1 + F_{EB(Y)} = 0$

$F_{EB(Y)} = 1$ KN

$$F_{EB} = \frac{F_{EB(Y)}}{sen45} = \frac{1}{\text{sen } 45} = 1{,}414 \text{ kN}$$

F_{EB} = 1,414 KN (tension)

$F_{EB\,(X)} = F_{EB}$ cos 45

$F_{EB\,(X)} = (1{,}414)$ cos 45

$F_{EB\,(X)} = 1$ KN

$\sum F_X = 0$

$F_{GE} - F_{EC} - F_{EB\,(X)} = 0$

PERO:
$F_{GE} = 5$ kN
$F_{EB\,(X)} = 1$ KN

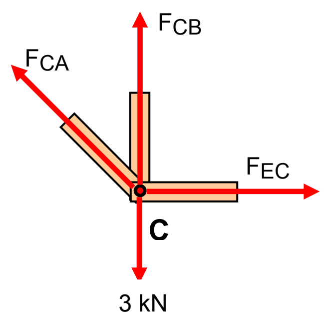
$F_{GE} - F_{EC} - F_{EB\,(X)} = 0$

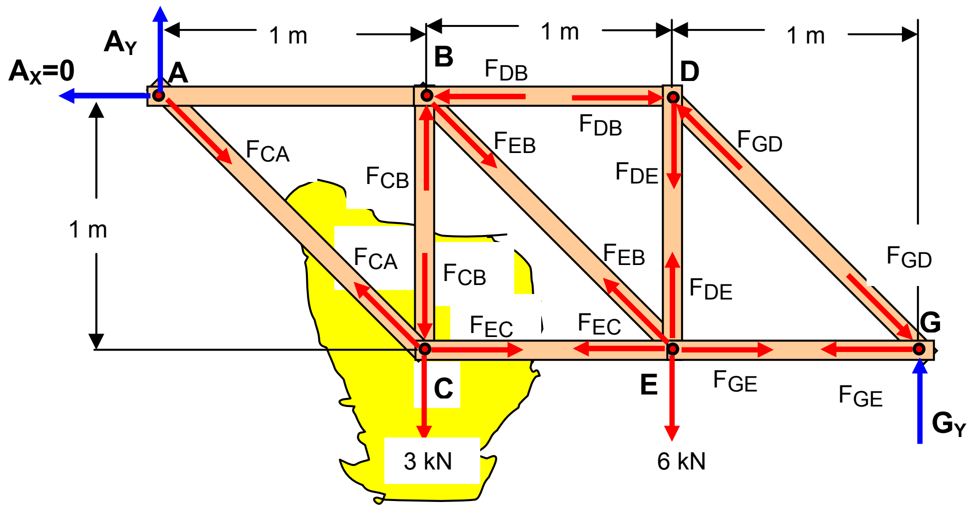
$5 - F_{EC} - 1 = 0$

$4 - F_{EC} = 0$

F_{EC} = 4 KN (tension)

NUDO C





$$\text{sen } 45 = \frac{F_{CA(Y)}}{F_{CA}}$$

$F_{CA\,(Y)} = F_{CA}$ sen 45

$$F_{CA(Y)} = F_{CA}\left(\frac{\sqrt{2}}{2}\right)$$

$$F_{CA(Y)} = \left(\frac{\sqrt{2}}{2}\right)F_{CA}$$

$\sum F_X = 0$

$F_{EC} - F_{AC\,(X)} = 0$

$F_{EC} = F_{AC\,(X)}$

PERO:

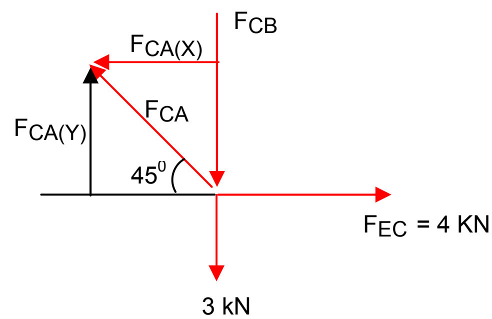
$F_{EC} = 4$ kN

$$\cos 45 = \frac{F_{CA(X)}}{F_{CA}}$$

$F_{CA\,(X)} = F_{CA}$ cos 45

$$F_{CA(X)} = F_{CA}\left(\frac{\sqrt{2}}{2}\right)$$

$$F_{CA(X)} = \left(\frac{\sqrt{2}}{2}\right)F_{CA}$$



$F_{AC\,(X)}$ = 4 kN

$F_{CA\,(X)} = F_{CA}$ cos 45

$$F_{CA} = \frac{F_{CA(X)}}{\cos 45} = \frac{4}{0{,}7071} = 5{,}656\text{kN}$$

F_{CA} = 5,656 KN (tension)

$$F_{CA(Y)} = \left(\frac{\sqrt{2}}{2}\right)F_{CA}$$

$$F_{CA(Y)} = \left(\frac{\sqrt{2}}{2}\right)5{,}656 = 4\text{ KN}$$

$F_{CA\,(Y)}$ = 4 kN

$\sum F_Y = 0$

$- F_{CB} - 3 + F_{CA(Y)} = 0$

PERO:

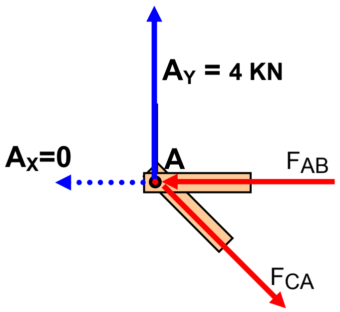
$F_{CA\,(Y)}$ = 4 kN

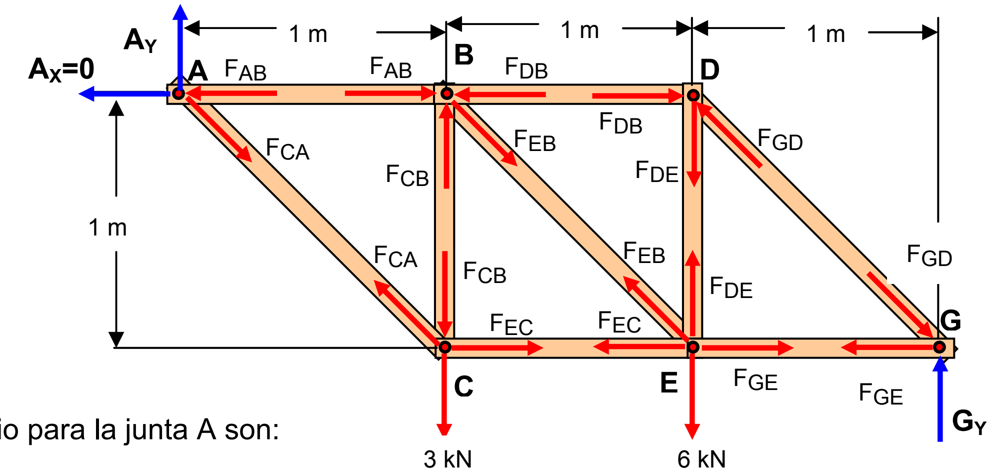
$- F_{CB} - 3 + 4 = 0$

$- F_{CB} + 1 = 0$

F_{CB} = 1 KN (compresión)

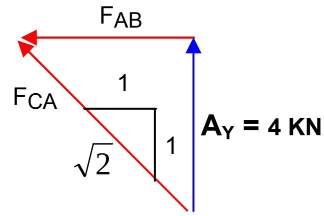
NUDO A





Las ecuaciones de equilibrio para la junta A son:

$$\frac{F_{CA}}{\sqrt{2}} = \frac{F_{AB}}{1} = \frac{A_Y}{1}$$



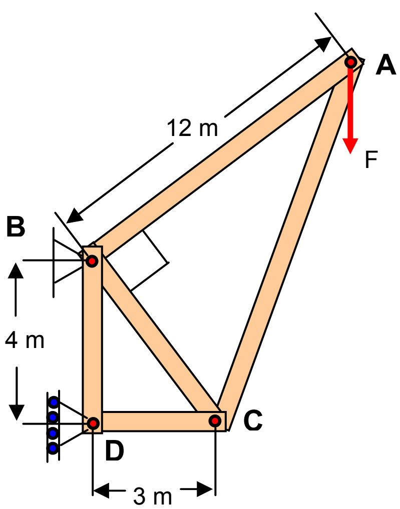
PERO: A_Y **= 4 KN**

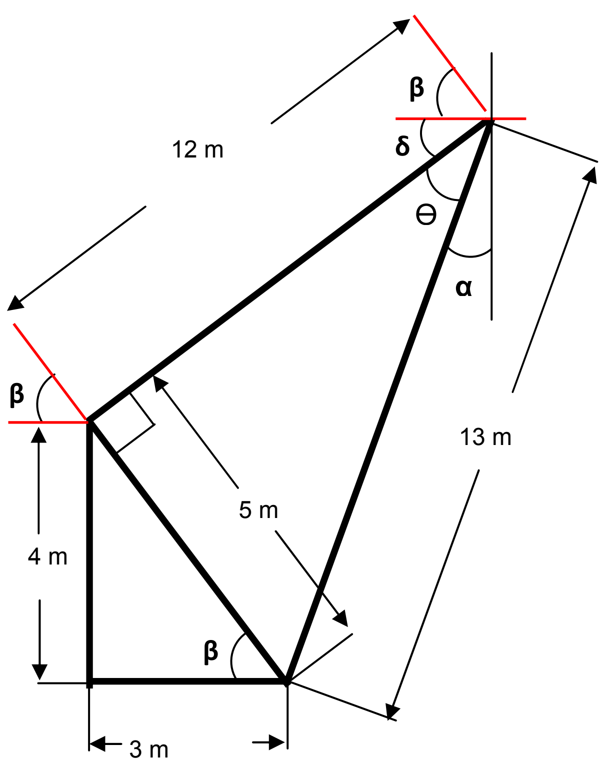
$$\frac{F_{AB}}{1} = \frac{A_Y}{1}$$

F_{AB} = 4 KN (compresión)

Problema 6.14 bedford edic 4

If you don't want the members of the truss to be subjected to an axial load (tension or compression) greater than 20 kn, what is the largest acceptable magnitude of the downward force F?





$$\text{tg}\,\theta = \frac{5}{12} = 0{,}4166$$

Θ = arc tg (0,4166)

Θ = 22,61⁰

$$\text{tg}\,\beta = \frac{4}{3} = 1{,}3333$$

β = arc tg (1,3333)

β = 53,12⁰

$\beta + \delta = 90^0$

$\delta = 90^0 - \beta$

$\delta = 90^0 - 53{,}12^0$

$\delta = 36{,}87^0$

$\delta + \Theta + \alpha = 90^0$

pero:
$\delta = 36{,}87^0$
$\Theta = 22{,}61^0$

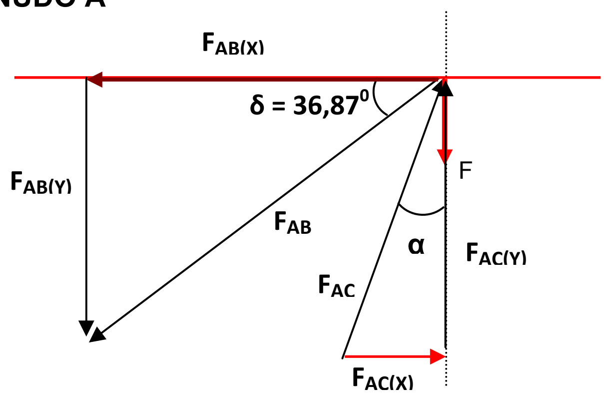
$\delta + \Theta + \alpha = 90^0$

$36{,}87 + 22{,}61 + \alpha = 90^0$

$\alpha = 90^0 - 36{,}87 - 22{,}61$

$\alpha = 30{,}52^0$

NUDO A



$$\text{sen}\,36{,}87 = \frac{F_{AB(Y)}}{F_{AB}}$$

$F_{AB\,(Y)} = F_{AB}\,\text{sen}\,36{,}87$

$$F_{AB(Y)} = (0{,}6)\,F_{AB}$$

$$\cos 36{,}87 = \frac{F_{AB(X)}}{F_{AB}}$$

$F_{AB\,(X)} = F_{AB}\cos 36{,}87$

$$F_{AB(X)} = (0{,}8)\,F_{AB}$$

$$\cos 30{,}52 = \frac{F_{AC(Y)}}{F_{AC}}$$

$F_{AC\,(Y)} = F_{AC}\cos 30{,}52$

$$F_{AC(Y)} = (0{,}8614)\,F_{AC}$$

$$\text{sen}\,\alpha = \frac{F_{AC(X)}}{F_{AC}}$$

$$\text{sen}\,30{,}52 = \frac{F_{AC(X)}}{F_{AC}}$$

$F_{AC\,(X)} = F_{AC}\,\text{sen}\,30{,}52$

$$F_{AC(X)} = (0{,}507)\,F_{AC}$$

$\sum F_X = 0$

$F_{AC(X)} - F_{AB\,(X)} = 0$

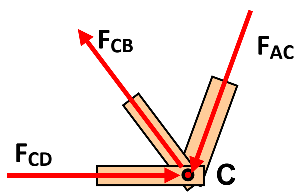
$0{,}507\,F_{AC} - 0{,}8\,F_{AB} = 0$ ECUACION 1

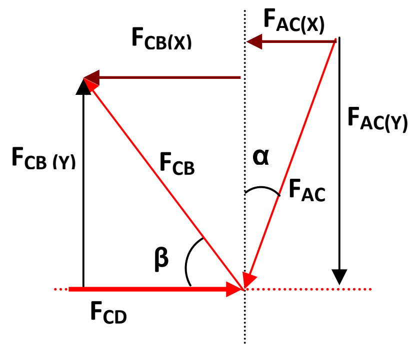
$\sum F_Y = 0$

$F_{AC\,(Y)} - F - F_{AB\,(Y)} = 0$

$0{,}8614\ F_{AC}\ - F\ - 0{,}6\ F_{AB}\ = 0$ **ECUACION 2**

NUDO C





$\beta = 53{,}12^0$

$$\text{sen } 53{,}12 = \frac{F_{CB(Y)}}{F_{CB}}$$

$F_{CB\,(Y)} = F_{CB}$ sen 53,12

$$F_{CB(Y)} = (0{,}7998)\,F_{CB}$$

$$\cos 53{,}12 = \frac{F_{CB(X)}}{F_{CB}}$$

$F_{CB\,(X)} = F_{CB}\cos 53{,}12$

$$F_{CB(X)} = (0{,}6)\,F_{CB}$$

$$F_{AC(X)} = (0{,}507)\,F_{AC}$$

$$F_{AC(Y)} = (0{,}8614)\,F_{AC}$$

$\sum F_X = 0$

$F_{CD} - F_{AC(X)} - F_{CB\,(X)} = 0$

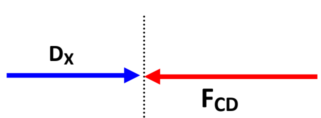
$F_{CD} - 0{,}507F_{AC} - 0{,}6\ F_{CB} = 0$ **ECUACION 3**

$\sum F_Y = 0$

$F_{CB\,(Y)} - F_{AC\,(Y)} = 0$

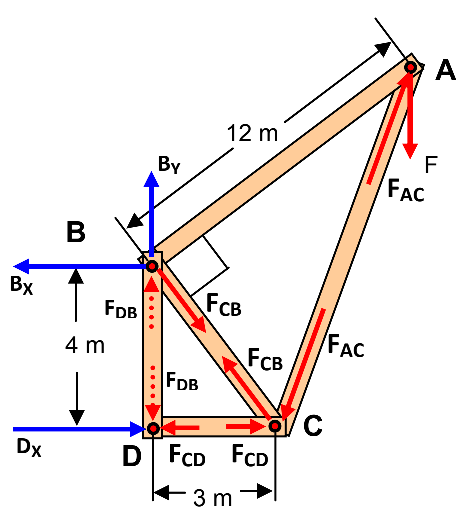
$0{,}7998\ F_{CB} - 0{,}8614\ F_{AC} = 0$ **ECUACION 4**

NUDO D



$\sum F_X = 0$

$D_X - F_{CD} = 0$ **ECUACION 5**



$0{,}507\ F_{AC} - 0{,}8\ F_{AB} = 0$ ECUACION 1
$0{,}8614\ F_{AC} - F - 0{,}6\ F_{AB} = 0$ ECUACION 2
$F_{CD} - 0{,}507F_{AC} - 0{,}6\ F_{CB} = 0$ ECUACION 3
$0{,}7998\ F_{CB} - 0{,}8614\ F_{AC} = 0$ ECUACION 4
$D_X - F_{CD} = 0$ ECUACION 5

DESPEJAMOS F en la ecuación 2
$0{,}8614\ F_{AC} - F - 0{,}6\ F_{AB} = 0$ ECUACION 2

$0{,}8614\ F_{AC} - 0{,}6\ F_{AB} = F$ ECUACION 6

Resolver la ecuación 1

$0,507\ F_{AC}\ - 0,8\ F_{AB}\ = 0$

$0,507\ F_{AC}\ = 0,8\ F_{AB}$

Despejando F_{AC}

$$F_{AC} = \frac{0,8}{0,507} F_{AB} = 1,577\ F_{AB}$$

$F_{AC} = 1,577\ F_{AB}$

Reemplazar **F_{AC}** en la ecuación 6

$0,8614\ F_{AC} - 0,6\ F_{AB}\ = F$ ECUACION 6

$0,8614\ (1,577\ F_{AB}) - 0,6\ F_{AB}\ = F$

$1,3592\ F_{AB}\ - 0,6\ F_{AB}\ = F$

$0,7592\ F_{AB}\ = F$

Despejando F_{AB}

$$F_{AB} = \frac{1}{0,7592} F = 1,317\ F$$

$F_{AB} = 1,317\ F$

Reemplazar **F_{AB}** en la ecuación 6

$0,8614\ F_{AC} - 0,6\ F_{AB}\ = F$ ECUACION 6

$0,8614\ F_{AC} - 0,6\ (1,317\ F)\ = F$

$0,8614\ F_{AC} - 0,79\ F\ = F$

$0,8614\ F_{AC}\ = F + 0,79\ F$

$0,8614\ F_{AC}\ = 1,79\ F$

$$F_{AC} = \frac{1,79}{0,8614} F = 2,078\ F$$

$F_{AC} = 2,078\ F$

Reemplazar F_{AC} en la ecuación 4

$0,7998\ F_{CB}\ - 0,8614\ F_{AC} = 0$ ECUACION 4

$0,7998\ F_{CB}\ - 0,8614\ (2,078\ F) = 0$

$0,7998\ F_{CB}\ - 1,79\ F = 0$

$0,7998\ F_{CB}\ = 1,79\ F$

$$F_{CB} = \frac{1,79}{0,7998} F = 2,238\ F$$

$F_{CB} = 2,238\ F$

Reemplazar F_{AC} y F_{CB} en la ecuación 3

$F_{AB} = 1,317\ F$
$F_{AC} = 2,078\ F$
$F_{CB} = 2,238\ F$
$F_{CD} = 2,395\ F$
$F_{DB} = 0$

$F_{CD} – 0,507F_{AC}$ $- 0,6\ F_{CB}$ $= 0$ ECUACION 3

$F_{CD} – 0,507\ (2,078\ F\ )$ $- 0,6\ (2,238\ F)$ $= 0$

$F_{CD} – 1,053\ F$ $- 1,342\ F$ $= 0$

$F_{CD} = 1,053\ F$ $+ 1,342\ F$

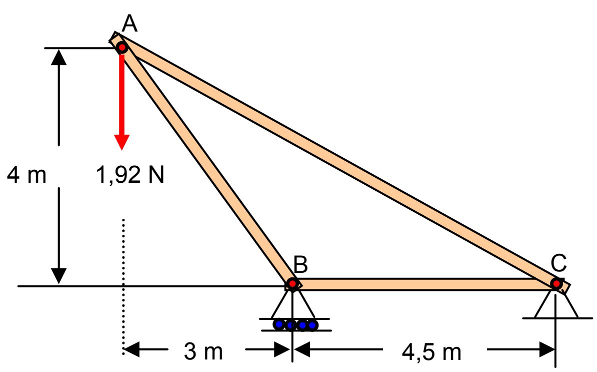
$F_{CD} = 2,395\ F$

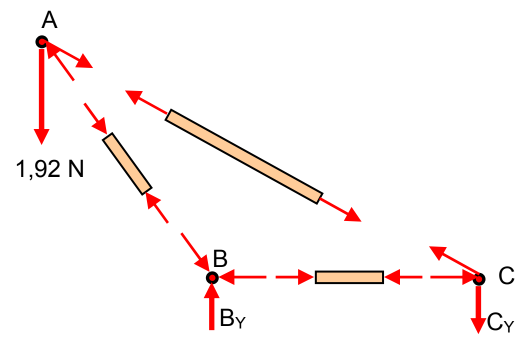
LA ESTRUCTURA MAS CRITICA ES F_{CD}
$2,395\ F = 20$

$$F = \frac{20}{2,395} = 8,35\ KN$$

F = 8,35 KN

Problema 6.1 beer edic 6
Por el método de los nudos, halla la fuerza en todas las barras de la armadura representada indicar en cada caso si es tracción o compresión.





$\Sigma\ M_B = 0$

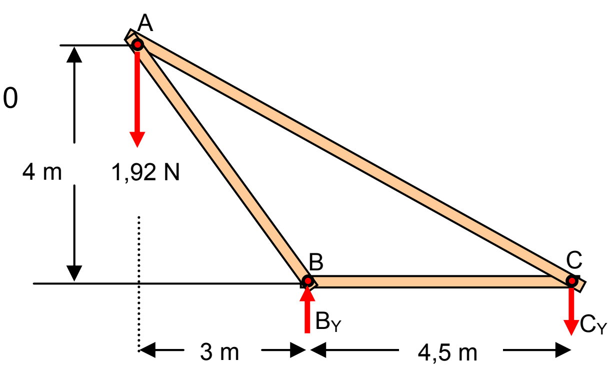
+ $1,92\ (\ 3)\ - C_Y\ (4,5) = 0$

$5,76\ - C_Y\ (4,5\ ) = 0$

$C_Y\ (4,5\ ) = 5,76$

$$C_Y = \frac{5,76}{4,5} = 1,28\ N$$

$C_Y = 1,28\ N$



la reacción en B?

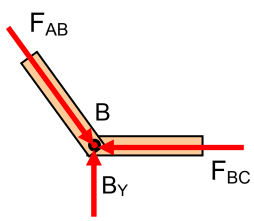
$\Sigma\ F_Y = 0$

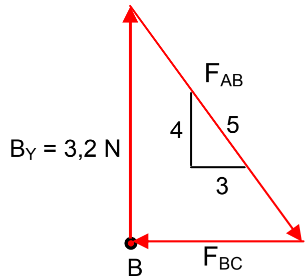
$B_Y – 1,92 - C_Y = 0$

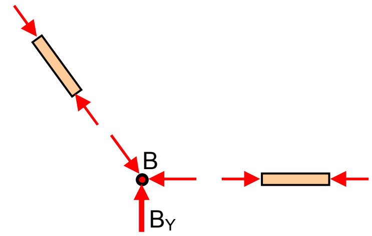
$B_Y – 1,92 – 1,28 = 0$

$B_Y = 3,2$ Newton

Nudo B







$$\frac{F_{AB}}{5} = \frac{F_{BC}}{3} = \frac{3,2}{4}$$

Hallar F_{AB}

$$\frac{F_{AB}}{5} = \frac{3,2}{4}$$

$$F_{AB} = \frac{(5)3,2}{4} = \frac{16}{4} = 4 \text{ N}$$

F_{AB} = 4 Newton(compresión)

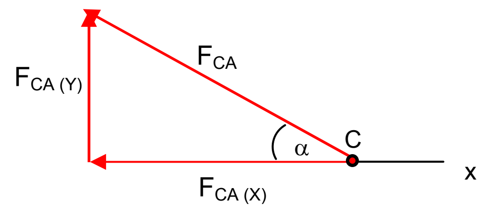
Hallar F_{BC}

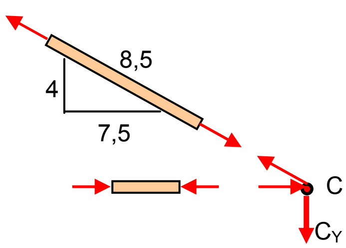
$$\frac{F_{BC}}{3} = \frac{3,2}{4}$$

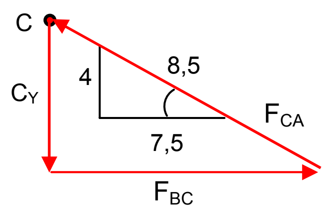
$$F_{BC} = \frac{(3)3,2}{4} = \frac{9,6}{4} = 2,4 \text{ N}$$

F_{Bc} = 2,4 Newton (compresión)

Nudo C







$$\cos \alpha = \frac{7,5}{8,5}$$

$F_{CA\,(X)}$ = cos α (F_{CA})

$$F_{CA}(X) = \frac{7,5}{8,5} F_{CA}$$

$$\operatorname{sen} \alpha = \frac{4}{8,5}$$

$F_{CA\,(Y)}$ = sen α (F_{CA})

$$F_{CA}(Y) = \frac{4}{8,5} F_{CA}$$

$\sum F_X = 0$

$F_{BC} - F_{CA\,(X)} = 0$

$$F_{BC} - \frac{7,5}{8,5} F_{CA} = 0$$

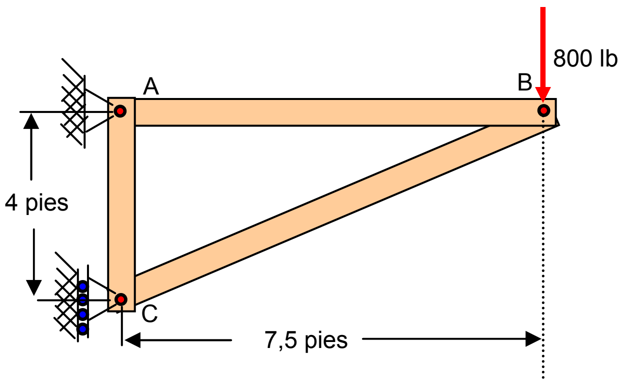
$$F_{BC} = \frac{7,5}{8,5} F_{CA}$$

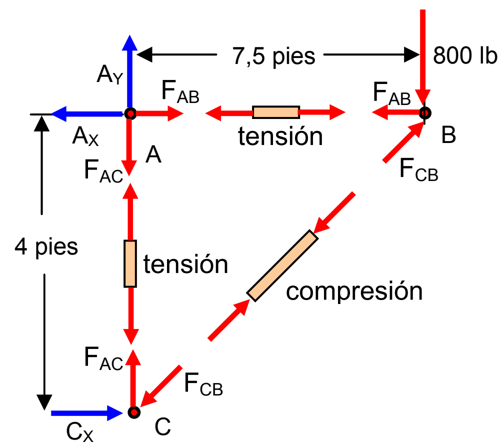
$$2,4 = \frac{7,5}{8,5} F_{CA}$$

$$F_{CA} = \frac{(2,4)8,5}{7,5} = \frac{20,4}{7,5} = 2,72 \text{ Newton}$$

F_{CA} = 2,72 Newton (tracción)

Problema 6.1 Beer edic 8
Utilice el método de los nodos para determinar la fuerza presente en cada elemento de las armaduras. Establezca si los elementos están en tensión o en compresión.





$\Sigma M_A = 0$

$+ \quad C_X(4) - 800(7{,}5) = 0$

$4\,C_X - 6000 = 0$

$4\,C_X = 6000$

$$C_X = \frac{6000}{4} = 1500 \text{ lb}$$

C_X = 1500 lb.

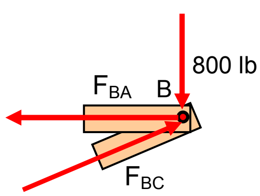
$\sum F_x = 0$

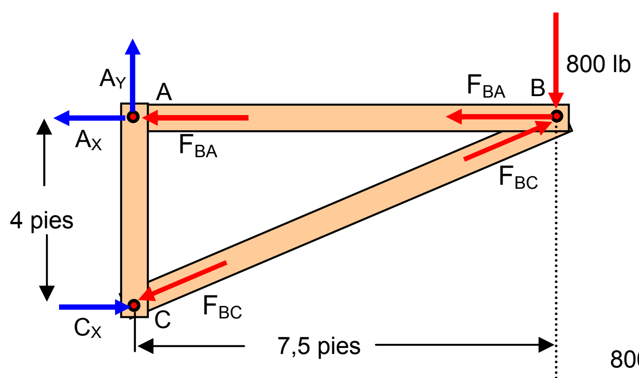
$C_X - A_X = 0$

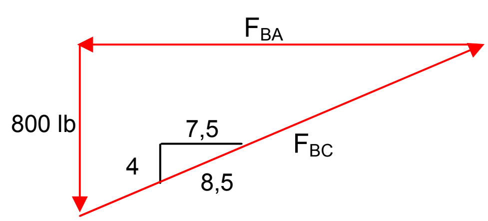
$C_X = A_X$

A_X = **1500 lb.**

Nudo B







$$\frac{F_{BA}}{7{,}5} = \frac{800}{4} = \frac{F_{BC}}{8{,}5}$$

$$\frac{F_{BA}}{7{,}5} = 200 = \frac{F_{BC}}{8{,}5}$$

Hallar F_{BA}

$$\frac{F_{BA}}{7{,}5} = 200$$

F_{BA} = 1500 N (tensión)

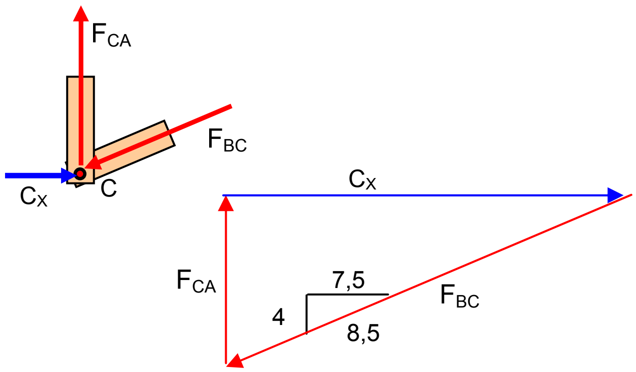
Hallar F_{BC}

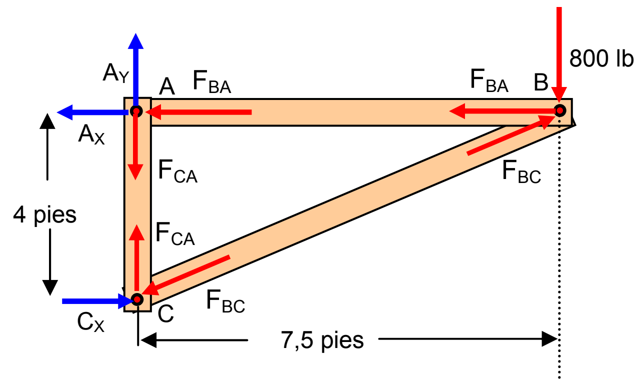
$$200 = \frac{F_{BC}}{8{,}5}$$

F_{BC} = 8,5 (200)

F_{BC} = 1700 N (compresión)

NUDO C





$$\frac{F_{CA}}{4}=\frac{C_X}{7,5}=\frac{F_{BC}}{8,5}$$

Pero:

F_{BC} = 1700 N (compresión)

$$\frac{F_{CA}}{4}=\frac{C_X}{7,5}=\frac{1700}{8,5}$$

$$\frac{F_{CA}}{4}=\frac{C_X}{7,5}=200$$

Hallar F_{cA}

$$\frac{F_{CA}}{4}=200$$

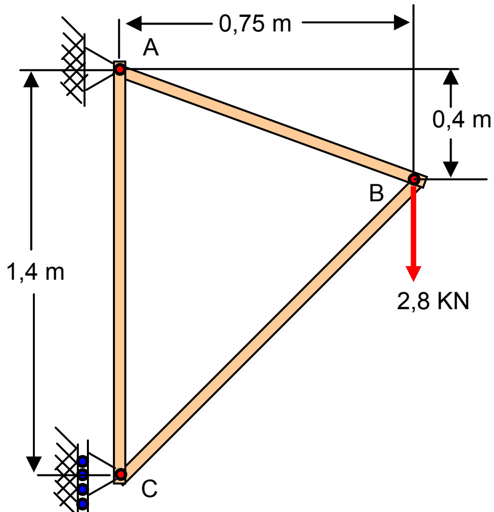
F_{CA} = 200 (4) = 800 N (tensión)

F_{BC} = 1700 N (compresión)

F_{BA} = 1500 N (tensión)

F_{CA} = 200 (4) = 800 N (tensión)

Problema 6.2 beer edic 6
Por el método de los nudos, halla la fuerza en todas las barras de la armadura representada indicar en cada caso si es tracción o compresión.



$\Sigma M_A = 0$

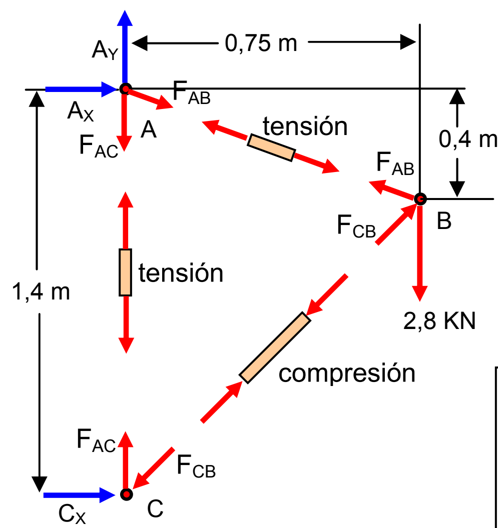
\+ $C_X (1,4) - 2,8 (0,75) = 0$

$C_X (1,4) = 2,8 (0,75)$

$1,4\ C_X = 2,1$

$$C_X = \frac{2,1}{1,4} = 1,5\ \text{N}$$

$C_X =$ 1,5 KNewton



$\sum F_Y = 0$

$A_Y - 2,8 = 0$

$A_Y =$ 2,8 KNewton

$\Sigma M_C = 0$

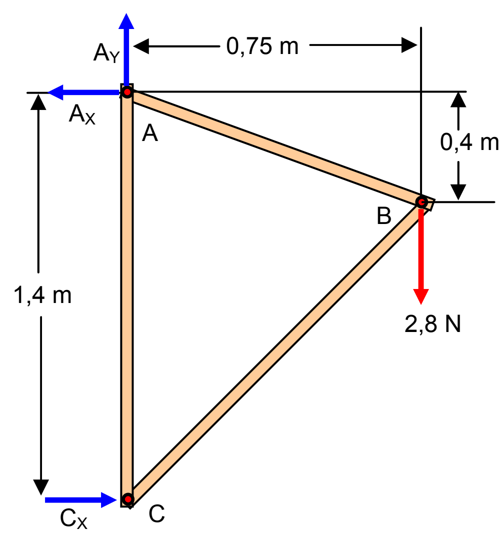
\+ $- A_X (1,4) - 2,8 (0,75) = 0$

$- A_X (1,4) = 2,8 (0,75)$

$-1,4\ A_X = 2,1$

$$A_X = -\frac{2,1}{1,4} = -1,5\ \text{N}$$

$A_X =$ - 1,5 KNewton (significa que la fuerza A_X esta direccionada hacia la izquierda)



$\Sigma M_C = 0$

\+ $A_X (1,4) - 2,8 (0,75) = 0$

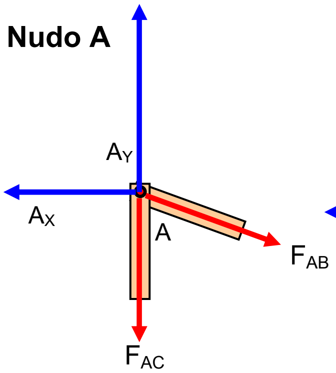
$A_X (1,4) = 2,8 (0,75)$

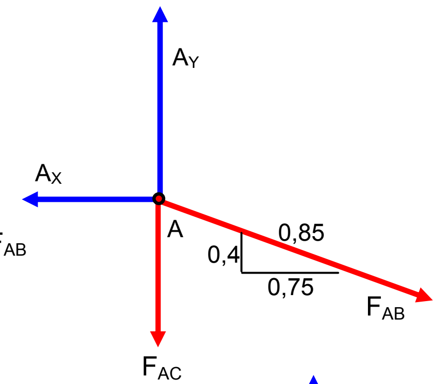
$1,4\ A_X = 2,1$

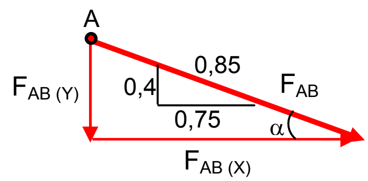
$$A_X = \frac{2,1}{1,4} = 1,5\ \text{N}$$

A_X = 1,5 KNewton

Nudo A







$$\cos\alpha = \frac{0{,}75}{0{,}85}$$

$F_{AB (X)}$ = cos α (F_{AB})

$$F_{AB}(X) = \frac{0{,}75}{0{,}85} F_{AB}$$

$\sum F_X = 0$

$-A_X + F_{AB (X)} = 0$

$$-A_X + \frac{0{,}75}{0{,}85} F_{AB} = 0$$

$$A_X = \frac{0{,}75}{0{,}85} F_{AB}$$

$$F_{AB} = \frac{0{,}85}{0{,}75} A_X$$

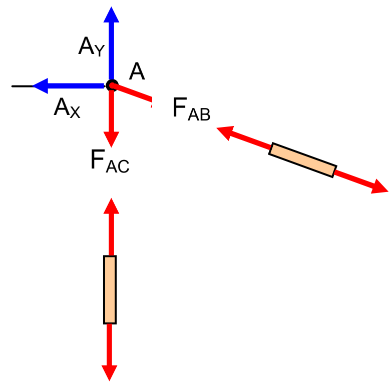
$$F_{AB} = \frac{0{,}85}{0{,}75} (1{,}5)$$

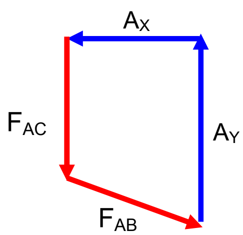
F_{AB} = 1,7 KNewton (tracción)

$$\text{sen}\,\alpha = \frac{0{,}4}{0{,}85}$$

$F_{AB (Y)}$ = sen α (F_{AB})

$$F_{AB}(Y) = \frac{0{,}4}{0{,}85} F_{AB}$$





$\sum F_Y = 0$

$A_Y - F_{AC} - F_{AB (Y)} = 0$

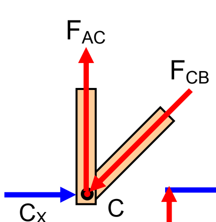
$$A_Y - F_{AC} - \frac{0{,}4}{0{,}85} F_{AB} = 0$$

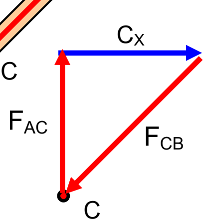
$$2{,}8 - F_{AC} - \frac{0{,}4}{0{,}85}(1{,}7) = 0$$

$$2{,}8 - 0{,}8 = F_{AC}$$

F_{AC} = 2 KNewton (Tracción)

Nudo C





$$\text{sen}\,\alpha = \frac{1}{1{,}25}$$

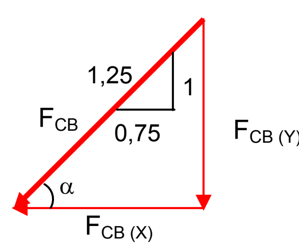
$F_{CB (Y)}$ = sen α (F_{CB})

$$F_{CB}(Y) = \left(\frac{1}{1{,}25}\right) F_{CB}$$

$$\cos\alpha = \frac{0{,}75}{1{,}25}$$

$F_{CB (X)}$ = sen α (F_{CB})

$$F_{CB}(X) = \left(\frac{0{,}75}{1{,}25}\right) F_{CB}$$



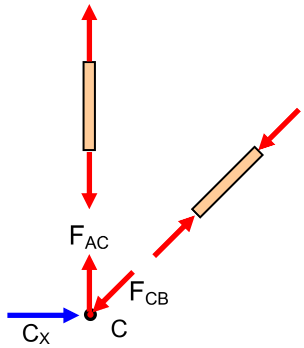
$\sum F_X = 0$

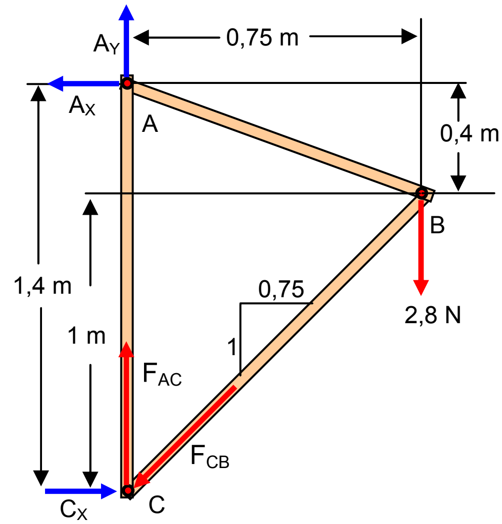
$C_X - F_{CB\,(X)} = 0$

$C_X = F_{CB\,(X)}$

$$C_X = \frac{0{,}75}{1{,}25} F_{CB}$$

$$F_{CB} = \frac{1{,}25}{0{,}75} C_X$$





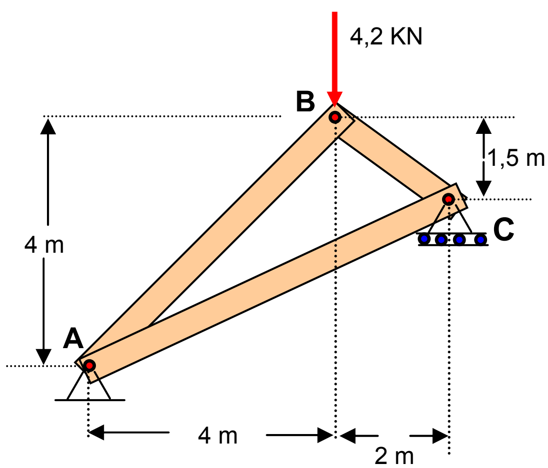
C_X = 1,5 KNewton

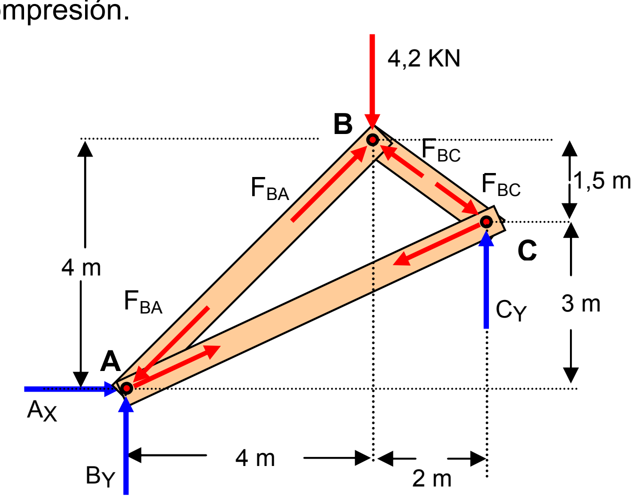
$$F_{CB} = \frac{1{,}25}{0{,}75}(1{,}5) = 2{,}5\,KN$$

F_{CB} = 2,5 KNewton (compresión)

Problema 6.2 beer edic 8

Utilice el método de los nodos para determinar la fuerza presente en cada elemento de las armaduras. Establezca si los elementos están en tensión o en compresión.





$\Sigma M_A = 0$

$C_Y\,(4 + 2) - 4{,}2\,(4) = 0$

$C_Y\,(6) - 16{,}8 = 0$

$6\,C_Y = 16{,}8$

$$C_Y = \frac{16{,}8}{6} = 2.8\,KN$$

C_Y = 2,8 KN

$\sum F_Y = 0$

$B_Y + C_Y - 4{,}2 = 0$

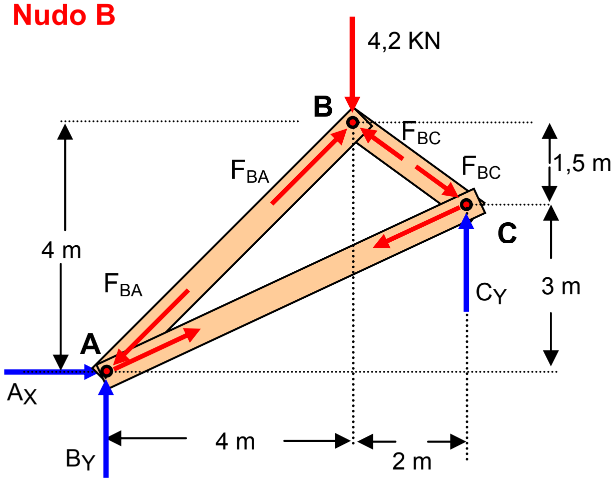
Pero: $C_Y = 2{,}8$ KN

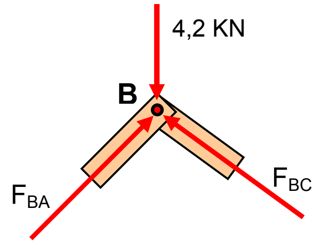
$B_Y + 2{,}8 - 4{,}2 = 0$

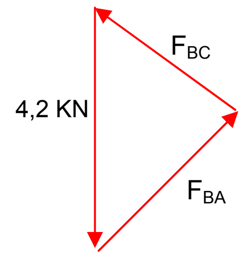
$B_Y - 1{,}4 = 0$

B_Y = 1,4 kN

Nudo B







$$\cos\alpha = \frac{2}{2,5} = 0,8$$

$$\cos\alpha = \frac{F_{BC(X)}}{F_{BC}}$$

$F_{BC\,(X)} = \cos\alpha\ (F_{BC})$

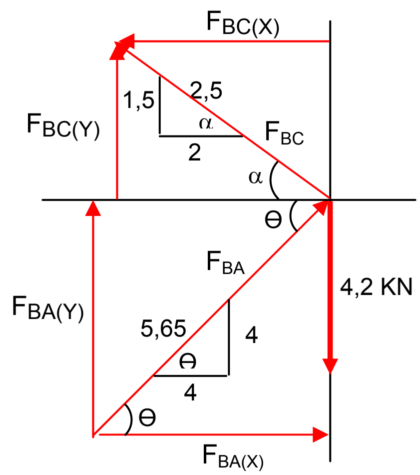
$$F_{BC\,(X)} = (0,8)\, F_{BC}$$

$$\text{sen}\ \alpha = \frac{1,5}{2,5} = 0,6$$

$$\text{sen}\ \alpha = \frac{F_{BC(Y)}}{F_{BC}}$$

$F_{BC\,(Y)} = \text{sen}\ \alpha\ (F_{BC})$

$$F_{BC\,(Y)} = (0,6)\, F_{BC}$$



$$\cos\theta = \frac{4}{5,65} = 0,7079$$

$$\cos\theta = \frac{F_{BA(X)}}{F_{BA}}$$

$F_{BA\,(X)} = \cos\Theta\ (F_{BA})$

$$F_{BA\,(X)} = (0,7079)\, F_{BA}$$

$$\text{sen}\ \theta = \frac{4}{5,65} = 0,7079$$

$$\text{sen}\ \theta = \frac{F_{BA(Y)}}{F_{BA}}$$

$F_{BA\,(Y)} = \text{sen}\ \Theta\ (F_{BA})$

$$F_{BA\,(Y)} = (0,7079)\, F_{BA}$$

$\sum F_Y = 0$

$F_{BC(Y)} + F_{BA\,(Y)} – 4,2 = 0$

$F_{BC(Y)} + F_{BA\,(Y)} = 4,2$

$0,6\ F_{BC} + 0,7079\ F_{BA} = 4,2$ **(Ecuación 2)**

$\sum F_X = 0$

$F_{BA(X)} – F_{BC\,(X)} = 0$

$0,7079\ F_{BA} - (0,8)\, F_{BC} = 0$ **(Ecuación 1)**

Resolver las ecuaciones

$0,7079\ F_{BA} - 0,8\ F_{BC} = 0\ (-1)$

$0,6\ F_{BC} + 0,7079\ F_{BA} = 4,2$

$\cancel{-\ 0,7079\ F_{BA}} + 0,8\ F_{BC} = 0$

$0,6\ F_{BC} + \cancel{0,7079\ F_{BA}} = 4,2$

$0,8\ F_{BC} + 0,6\ F_{BC} = 4,2$

$1,4\ F_{BC} = 4,2$

$$F_{BC} = \frac{4,2}{1,4} = 3\ KN$$

F_{BC} = 3 KN (compresión)

Reemplazando en la ecuación 1

$0,7079\ F_{BA} - 0,8\ F_{BC} = 0$

Pero:
$F_{BC} = 3\ KN$

$0,7079\ F_{BA} - 0,8\ (3) = 0$

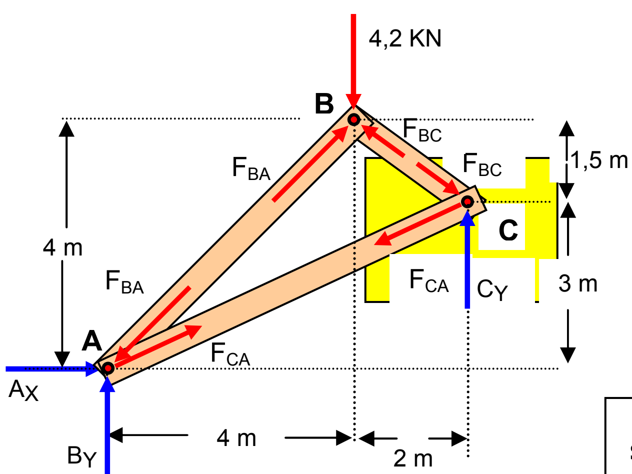
$0,7079\ F_{BA} - 2,4 = 0$

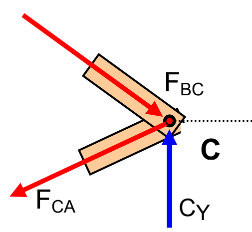
$0,7079\ F_{BA} = 2,4$

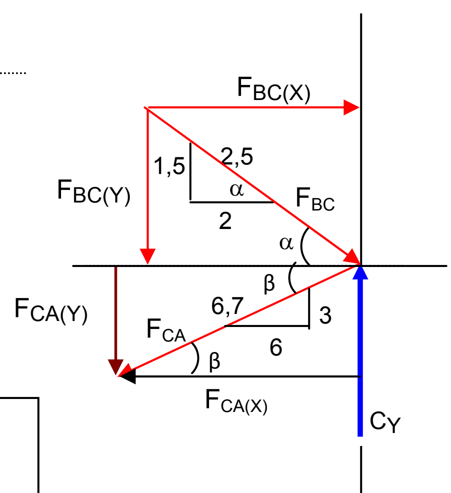
$$F_{BA} = \frac{2,4}{0,7079} = 3,39\ KN$$

F_{BC} = 3,39 KN (compresión)

NUDO C







$$\cos \alpha = \frac{2}{2,5} = 0,8 \qquad \cos \alpha = \frac{F_{BC(X)}}{F_{BC}}$$

$F_{BC\ (X)} = \cos \alpha\ (F_{BC})$

$$F_{BC(X)} = (0,8)\, F_{BC}$$

$$\text{sen}\ \alpha = \frac{1,5}{2,5} = 0,6$$

$$\text{sen}\ \alpha = \frac{F_{BC(Y)}}{F_{BC}}$$

$F_{BC\ (Y)} = \text{sen}\ \alpha\ (F_{BC})$

$$F_{BC(Y)} = (0,6)\, F_{BC}$$

$$\cos\beta = \frac{6}{6,7} = 0,8955 \qquad \cos\alpha = \frac{F_{CA(X)}}{F_{CA}}$$

$F_{CA\,(X)} = \cos\beta\ (F_{CA})$

$$F_{CA\,(X)} = (0,8955)\,F_{CA}$$

$$\operatorname{sen}\beta = \frac{3}{6,7} = 0,4477$$

$$\operatorname{sen}\beta = \frac{F_{CA(Y)}}{F_{CA}}$$

$F_{CA\,(Y)} = \operatorname{sen}\beta\ (F_{CA})$

$$F_{CA\,(Y)} = (0,4477)\,F_{CA}$$

$\sum F_X = 0$

$F_{BC(X)} - F_{CA\,(X)} = 0$

$(0,8)\,F_{BC} - (0,8955)\,F_{CA} = 0$ **(Ecuación 1)**

PERO:

F_{BC} = 3 KN (compresión)

$$(0,8)\,F_{BC} - (0,8955)\,F_{CA} = 0$$
$$(0,8)(3) - (0,8955)\,F_{CA} = 0$$
$$2,4 - (0,8955)\,F_{CA} = 0$$

$0,8955\ F_{CA} = 2,4$

$$F_{CA} = \frac{2,4}{0,8955} = 2,68\ \text{KN}$$

F_{CA} = 3 KN (tension)

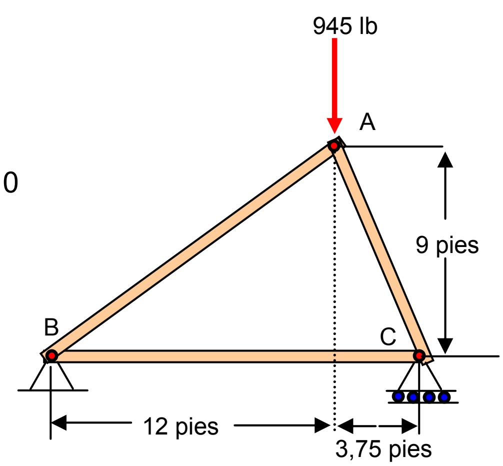
F_{BC} = 3,39 KN (compresión)

F_{BC} = 3 KN (compresión)

F_{CA} = 3 KN (tension)

Problema 6.3 beer edic 6

Por el método de los nudos, halla la fuerza en todas las barras de la armadura representada indicar en cada caso si es tracción o compresión.



$\sum F_X = 0 \quad B_X = 0$

$\Sigma M_B = 0$

$+\ \ C_Y\ (12 + 3,75) - 945\ (12) = 0$

$C_Y\ (15,75) - 945\ (12) = 0$

$C_Y\ (15,75) = 945\ (12)$

$15,75\ C_Y = 11340$

$$C_Y = \frac{11340}{15,75} = 720\ \text{lb}$$

C_Y = 720 lb

$\Sigma M_C = 0$

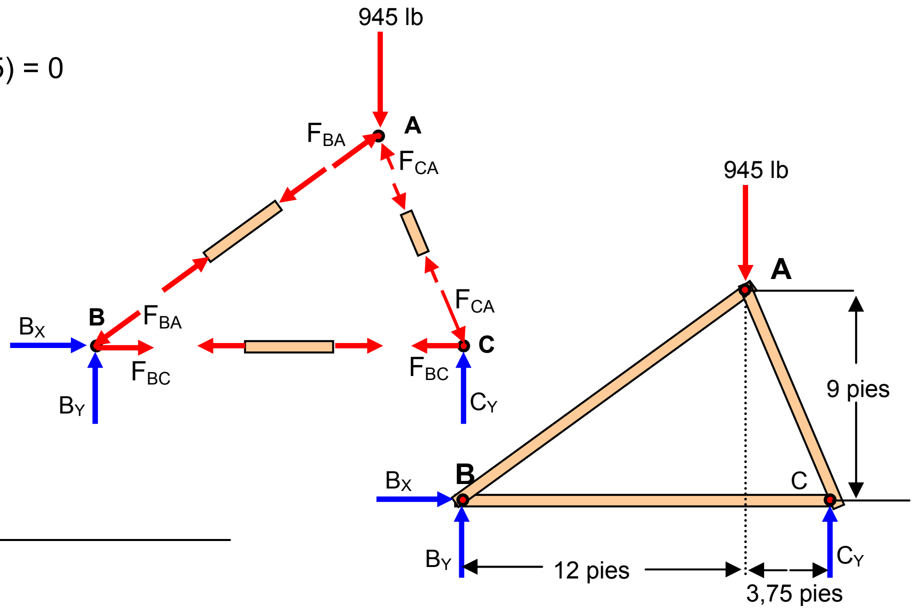
$945\,(3{,}75) - B_Y\,(12 + 3{,}75) = 0$

$945\,(3{,}75) = B_Y\,(15{,}75)$

$3543{,}75 = 15{,}75\,B_Y$

$$B_Y = \frac{3543{,}75}{15{,}75} = 225\text{ lb}$$

B_Y = 225 lb.



NUDO B

$$\operatorname{sen}\alpha = \frac{9}{15}$$

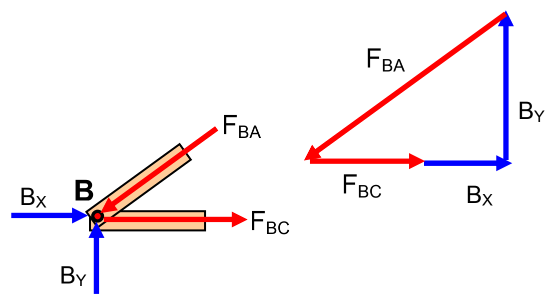
$F_{BA\,(X)} = \operatorname{sen}\,\alpha\,(F_{BA})$

$$F_{BA(X)} = \left(\frac{9}{15}\right) F_{BA}$$

$$\cos\alpha = \frac{12}{15}$$

$F_{BA\,(Y)} = \operatorname{sen}\,\alpha\,(F_{BA})$

$$F_{BA(Y)} = \left(\frac{12}{15}\right) F_{BA}$$



$$\frac{F_{BA}}{15} = \frac{F_{BC}}{12} = \frac{B_Y}{9}$$

$$\frac{F_{BA}}{15} = \frac{F_{BC}}{12} = \frac{225}{9}$$

Hallar F_{BA}

$$\frac{F_{BA}}{15} = \frac{225}{9}$$

$$F_{BA} = \frac{(15)\,225}{9} = 375\text{ lb.}$$

F_{BA} = 375 lb. (compresión)

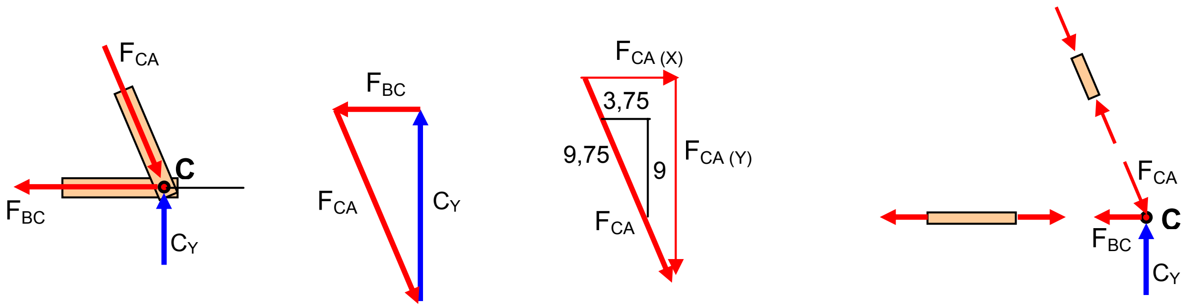
Hallar F_{BC}

$$\frac{F_{BC}}{12} = \frac{225}{9}$$

$$F_{BC} = \frac{(12)\,225}{9} = 300\text{ lb.}$$

F_{BC} = 300 lb. (tracción)

Nudo C



$$\frac{F_{CA}}{9{,}75} = \frac{F_{BC}}{3{,}75} = \frac{C_Y}{9}$$

$$\frac{F_{CA}}{9{,}75} = \frac{F_{BC}}{3{,}75}$$

Hallar F_{CA}

$$F_{CA} = \frac{(9{,}75)300}{3{,}75} = 780\ \text{lb}$$

F_{CA} = 780 lb. (compresión)

C_Y = 720 lb

B_Y = 225 lb.

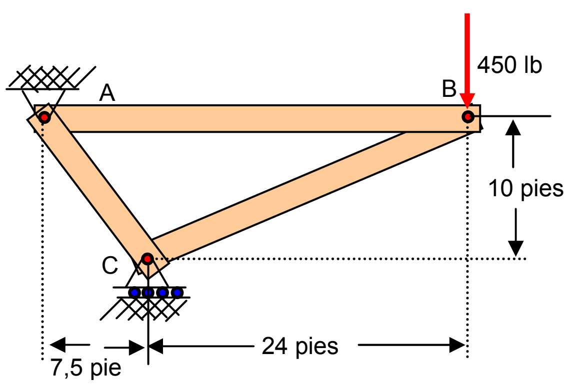
F_{BA} = 375 lb. (compresión)

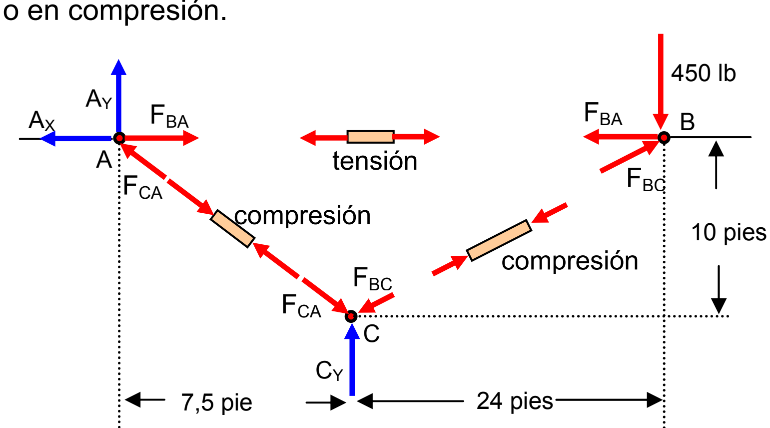
F_{BC} = 300 lb. (tracción)

F_{CA} = 780 lb. (compresión)

Problema 6.3 Beer edic 8

Utilice el método de los nodos para determinar la fuerza presente en cada elemento de las armaduras. Establezca si los elementos están en tensión o en compresión.





$\Sigma M_A = 0$

+ C_Y (7,5) - 450 (7,5 + 24) = 0

7,5 C_Y - 450 (31,5) = 0

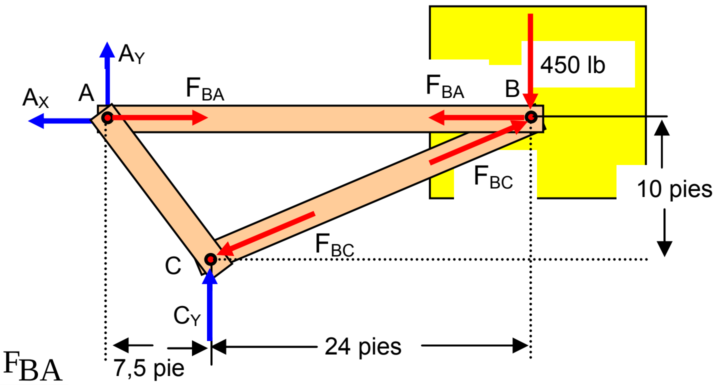
7,5 C_Y - 14175 = 0

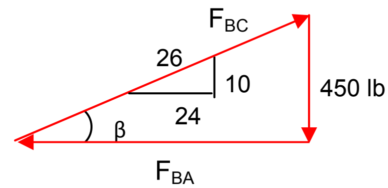
7,5 C_Y = 14175

$$C_Y = \frac{14175}{7.5} = 1890\ \text{lb}$$

C_Y = 1890 lb.

NUDO B





$$\frac{F_{BC}}{\cancel{26}} = \frac{450}{\cancel{10}} = \frac{F_{BA}}{\cancel{24}}$$

Cancelando términos semejantes

$$\frac{F_{BC}}{13} = \frac{450}{5} = \frac{F_{BA}}{12}$$

$$\frac{F_{BC}}{13} = 90 = \frac{F_{BA}}{12}$$

Hallar F_{BA}

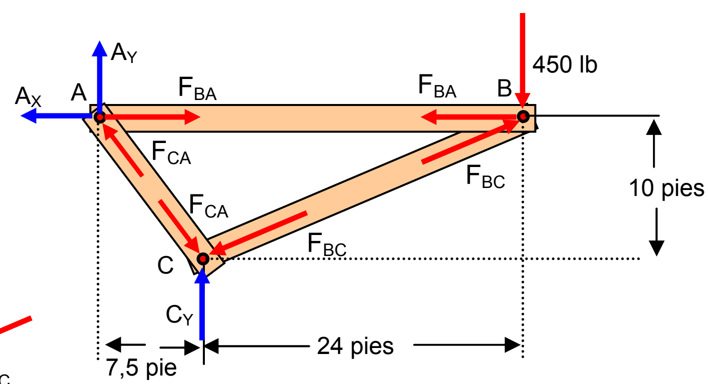
$$90 = \frac{F_{BA}}{12}$$

F_{BA} = 90 (12) = 1080 lb (tensión)

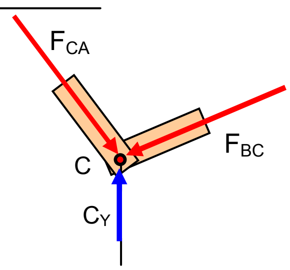
Hallar F_{BC}

$$\frac{F_{BC}}{13} = 90$$

F_{BC} = 90 (13) = 1170 lb (compresión)



NUDO C



$$\cos\alpha = \frac{7,5}{12,5} = 0,6$$

$$\cos\alpha = \frac{F_{CA(X)}}{F_{CA}}$$

$F_{CA\,(X)}$ = cos α (F_{CA})

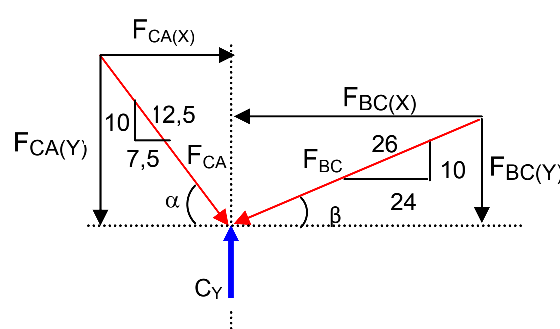
$$F_{CA}(X) = (0,6)\,F_{CA}$$

$$\operatorname{sen}\alpha = \frac{10}{12,5} = 0,8$$

$$\operatorname{sen}\alpha = \frac{F_{CA(Y)}}{F_{CA}}$$

$F_{CA\,(Y)}$ = sen α (F_{CA})

$$F_{CA}(Y) = (0,8)\,F_{CA}$$



$$\cos\beta = \frac{24}{26} = 0{,}923$$

$$\cos\alpha = \frac{F_{BC}(X)}{F_{BC}}$$

$F_{BC\,(X)} = \cos\alpha\,(F_{BC})$

$$F_{BC}(X) = (0{,}923)\,F_{BC}$$

$$\text{sen}\,\beta = \frac{10}{26} = 0{,}3846$$

$$\text{sen}\,\beta = \frac{F_{BC}(Y)}{F_{BC}}$$

$F_{BC\,(Y)} = \text{sen}\,\beta\,(F_{BC})$

$$F_{BC}(Y) = (0{,}3846)\,F_{BC}$$

$\sum F_Y = 0$

$C_Y - F_{CA(Y)} - F_{BC\,(Y)} = 0$

Pero: $C_Y = 1890$ lb.

$1890 - F_{CA(Y)} - F_{BC\,(Y)} = 0$

$F_{CA(Y)} + F_{BC\,(Y)} = 1890$

$0{,}8\,F_{CA} + 0{,}3846\,F_{BC} = 1890$ **(Ecuación 2)**

$\sum F_X = 0$

$F_{CA\,(X)} - F_{BC(X)} = 0$

$(0{,}6)\,F_{CA} - (0{,}923)\,F_{BC} = 0$ **(Ecuación 1)**

Resolver las ecuaciones

$0{,}6\,F_{CA} - 0{,}923\,F_{BC} = 0\ (0{,}3846)$

$0{,}8\,F_{CA} + 0{,}3846\,F_{BC} = 1890\ (0{,}923)$

$0{,}23\,F_{CA} - \cancel{0{,}354\,F_{BC}} = 0$

$0{,}7384\,F_{CA} + \cancel{0{,}354\,F_{BC}} = 1744{,}47$

$0{,}23\,F_{CA} + 0{,}7384\,F_{CA} = 1744{,}47$

$0{,}9684\,F_{CA} = 1744{,}47$

$$F_{CA} = \frac{1744{,}47}{0{,}9684} = 1801{,}39\ \text{KN}$$

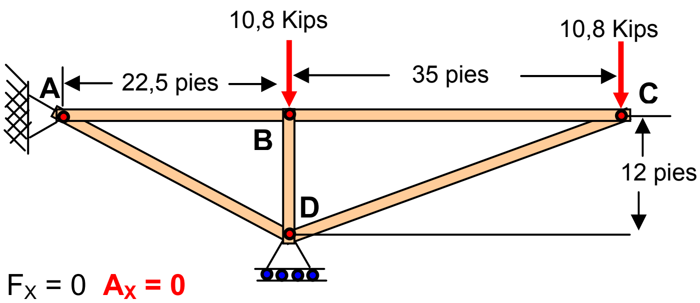
F_{CA} = 1801,39 KN (compresión)

F_{BA} = 90 (12) = 1080 lb (tensión)

F_{BC} = 90 (13) = 1170 lb (compresión)

F_{CA} = 1801,39 KN (compresión)

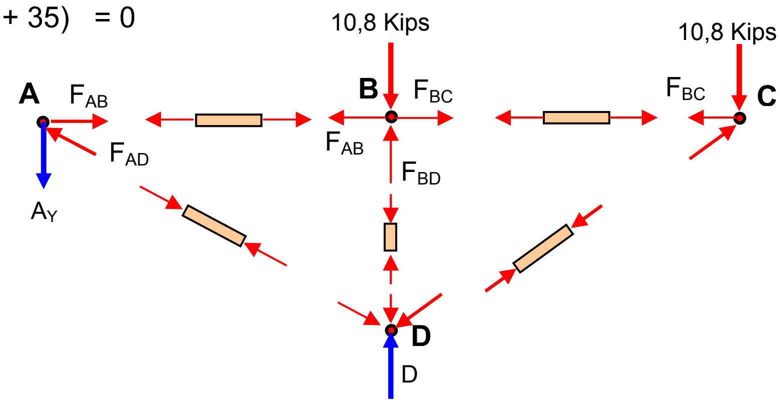
Problema 6.4 beer edic 6
Por el método de los nudos, halla la fuerza en todas las barras de la armadura representada indicar en cada caso si es tracción o compresión.



$\sum F_X = 0$ $\mathbf{A_X = 0}$

$\Sigma M_A = 0$

$D (22,5) - 10,8 (22,5) - 10,8 (22,5 + 35) = 0$



$D (22,5) - 10,8 (22,5) - 10,8 (57,5) = 0$

$22,5\ D - 243 - 621 = 0$

$22,5\ D = 864$

$$D = \frac{864}{22,5} = 38,4 \text{ Kips}$$

D = 38,4 Kips

$\Sigma M_C = 0$

$A_Y (22,5 + 35) + 10,8 (35) - D (35) = 0$

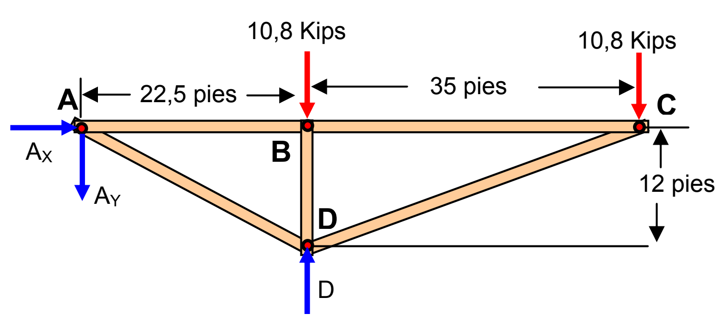
$A_Y (57,5) + 10,8 (35) - (38,4) (35) = 0$

$57,5\ A_Y + 378 - 1344 = 0$

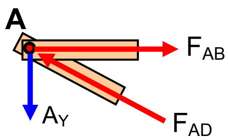
$57,5\ A_Y = 966$

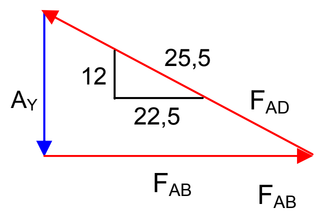
$$A_Y = \frac{966}{57,5} = 16,8 \text{ Kips}$$

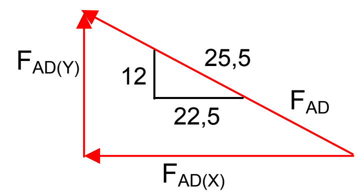
$\boxed{\mathbf{A_Y = 16,8\ Kips}}$

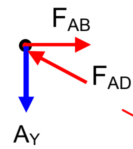


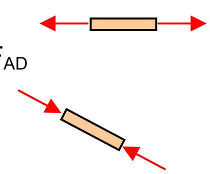
Nudo A











$$\frac{F_{AD}}{25,5} = \frac{F_{AB}}{22,5} = \frac{A_Y}{12}$$

A_Y = 16,8 Kips

$$\frac{F_{AD}}{25,5} = \frac{F_{AB}}{22,5} = \frac{16,8}{12}$$

Hallar F_{AB}

$$\frac{F_{AB}}{22,5} = \frac{16,8}{12}$$

$$F_{AB} = \frac{(22,5)16,8}{12} = 31,5 \text{ Kips}$$

F_{AB} = 35,7 Kips (tensión)

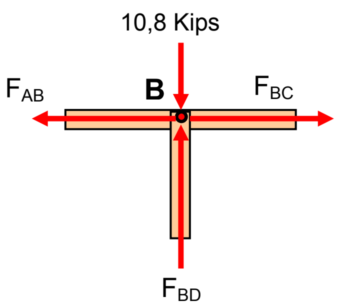
Hallar F_{AD}

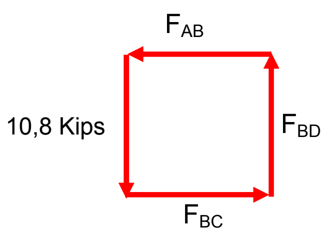
$$\frac{F_{AD}}{25,5} = \frac{16,8}{12}$$

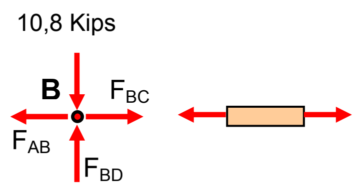
$$F_{AD} = \frac{(25,5)16,8}{12} = 35,7 \text{ Kips}$$

F_{AD} = 35,7 Kips (compresión)

Nudo B







$\sum F_X = 0$

$F_{BC} - F_{AB} = 0$

F_{AB} = 35,7 Kips

$F_{BC} = F_{AB}$

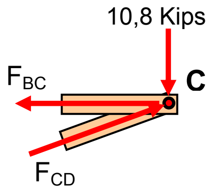
F_{BC} = 35,7 Kips (tensión)

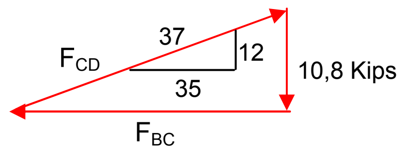
$\sum F_Y = 0$

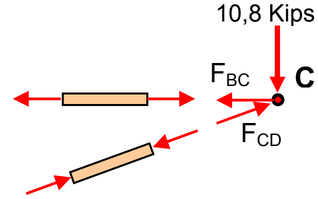
$F_{BD} - 10,8 = 0$

F_{BD} = 10,8 Kips (compresión)

Nudo C







$$\frac{F_{CD}}{37} = \frac{F_{BC}}{35} = \frac{10,8}{12}$$

Hallar F_{CD}

$$\frac{F_{CD}}{37} = \frac{10,8}{12}$$

$$F_{CD} = \frac{(37)10,8}{12} = 33,3 \text{ Kips}$$

F_{CD} = 33,3 Kips (compresión)

$A_X = 0$ D = 38,4 Kips

A_Y = 16,8 Kips

F_{AB} = 35,7 Kips (tensión)

F_{AD} = 35,7 Kips (compresión)

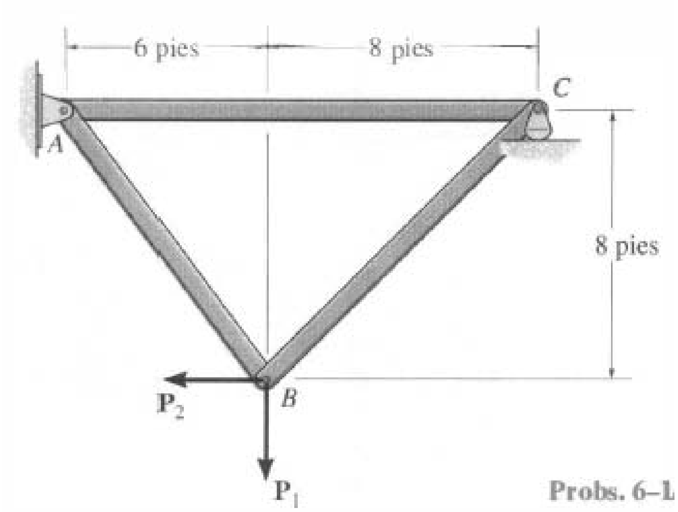
F_{BC} = 35,7 Kips (tensión)

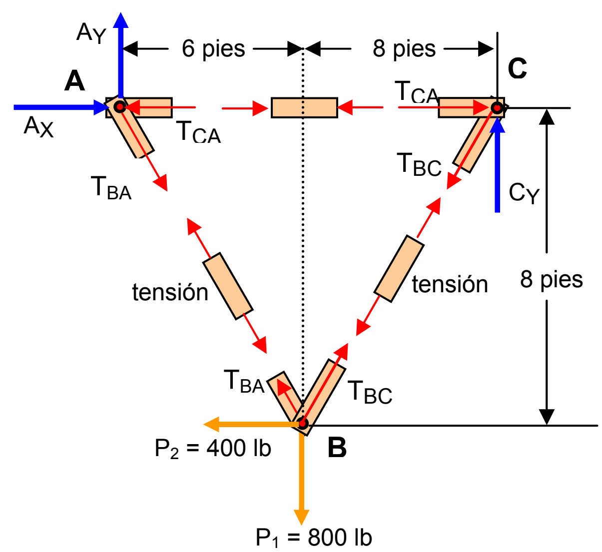
F_{BD} = 10,8 Kips (compresión)

F_{CD} = 33,3 Kips (compresión)

Problema 6.1 Estática Hibbeler edic 10

Determine la fuerza en cada miembro de la armadura y establezca si los miembros están en tensión o en compresión. Considere P_1 = 800 lb. y P_2 = 400 lb.





$\Sigma M_A = 0$

+ - 400 (8) - 800 (6) + C_Y (6 + 8) = 0

- 400 (8) - 800 (6) + C_Y (14) = 0

- 3200 - 4800 + C_Y (14) = 0

$\Sigma F_X = 0$

$A_X - 400 = 0$

A_X = 400 lb.

$- 8000 \quad + C_Y\,(14) = 0$

$C_Y\,(14) = 8000$

$$C_Y = \frac{8000}{14} = 571{,}42\ \text{lb}$$

C_Y = 571,42 lb

$\Sigma\, M_C = 0$

$+ \qquad - A_Y\,(6 + 8) - 400\,(8) \;+ 800\,(8) = 0$

$- A_Y\,(14) - 400\,(8) \;+ 800\,(8) = 0$

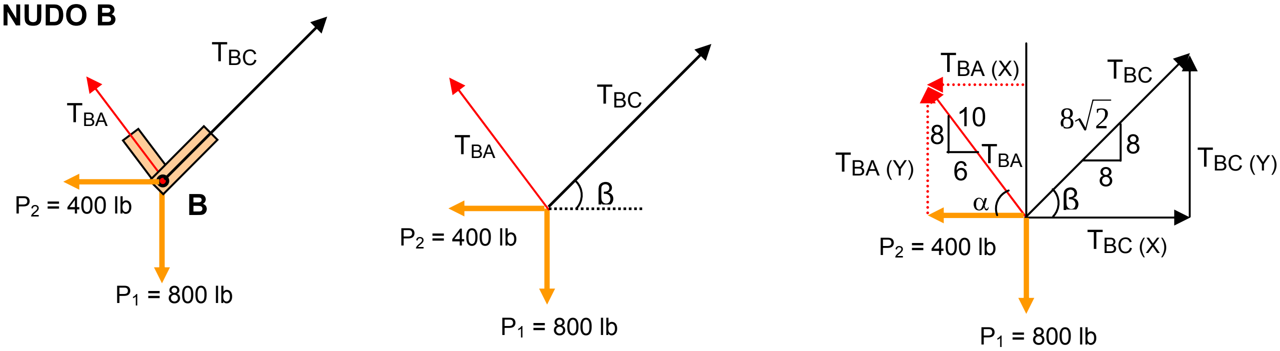
$- 14\, A_Y - 3200 = 0$

$14\, A_Y = 3200$

$$A_Y = \frac{3200}{14} = 228{,}57\ \text{lb}$$

A_Y = 228,57 lb

NUDO B



$$\text{sen}\ \alpha = \frac{8}{10} = \frac{4}{5}$$

$$\text{cos}\ \alpha = \frac{6}{10} = \frac{3}{5}$$

$$\boxed{\begin{aligned} \text{sen}\ \beta &= \frac{8}{8\sqrt{2}} = \frac{\sqrt{2}}{2} \\ \text{cos}\ \beta &= \frac{8}{8\sqrt{2}} = \frac{\sqrt{2}}{2} \end{aligned}}$$

$$\text{sen}\ \alpha = \frac{T_{BA(Y)}}{T_{BA}} \Rightarrow\ T_{BA(Y)} = \text{sen}\,\alpha\,(T_{BA})$$

$$T_{BA(Y)} = \left(\frac{4}{5}\right)(T_{BA})$$

$$\cos\alpha = \frac{T_{BA(X)}}{T_{BA}} \Rightarrow T_{BA(X)} = \cos\alpha\,(T_{BA})$$

$$T_{BA(X)} = \left(\frac{3}{5}\right)(T_{BA})$$

$$\operatorname{sen}\beta = \frac{T_{BC(Y)}}{T_{BC}} \Rightarrow T_{BC(Y)} = \operatorname{sen}\beta\,(T_{BC})$$

$$T_{BC(Y)} = \left(\frac{\sqrt{2}}{2}\right)(T_{BC})$$

$$\cos\beta = \frac{T_{BC(X)}}{T_{BC}} \Rightarrow T_{BC(X)} = \cos\beta\,(T_{BC})$$

$$T_{BC(X)} = \left(\frac{\sqrt{2}}{2}\right)(T_{BC})$$

$\sum F_X = 0$

$-400 + T_{BC\,(X)} - T_{BA\,(X)} = 0$

$T_{BC\,(X)} - T_{BA\,(X)} = 400$

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}T_{BA} = 400 \quad \textbf{(Ecuación 1)}$$

$\sum F_Y = 0$

$-800 + T_{BC\,(Y)} + T_{BA\,(Y)} = 0$

$T_{BC\,(Y)} + T_{BA\,(Y)} = 800$

$$\frac{\sqrt{2}}{2}(T_{BC}) + \frac{4}{5}T_{BA} = 800 \quad \textbf{(Ecuación 2)}$$

resolver ecuación 1 y ecuación 2

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}T_{BA} = 400 \quad \textbf{(-1)}$$

$$\frac{\sqrt{2}}{2}(T_{BC}) + \frac{4}{5}T_{BA} = 800$$

$$\cancel{-\frac{\sqrt{2}}{2}(T_{BC})} + \frac{3}{5}T_{BA} = -400$$

$$\cancel{\frac{\sqrt{2}}{2}(T_{BC})} + \frac{4}{5}T_{BA} = 800$$

$$\frac{7}{5}T_{BA} = 400$$

$$T_{BA} = \frac{(400)5}{7}$$

T_{BA} = 285,71 lb. (Tensión)

Reemplazando en la ecuación 1

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}T_{BA} = 400 \quad \textbf{(Ecuación 1)}$$

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}(285{,}71) = 400$$

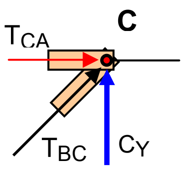
$$\frac{\sqrt{2}}{2}(T_{BC}) - 171{,}42 = 400$$

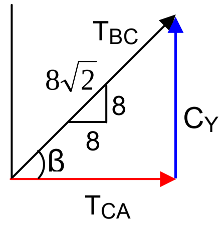
$$\frac{\sqrt{2}}{2}(T_{BC}) = 571{,}42$$

$$T_{BC} = \left(\frac{2}{\sqrt{2}}\right)571{,}42$$

T_{BC} = 808,12 lb. (Tensión)

NUDO C





Las ecuaciones de equilibrio para el nudo C son:

$$\frac{T_{CA}}{8} = \frac{T_{BC}}{8\sqrt{2}} = \frac{C_Y}{8}$$

Hallar T_{CA}

$$\frac{T_{CA}}{8} = \frac{T_{BC}}{8\sqrt{2}}$$

Pero:

$T_{BC} = 808{,}12$ lb.

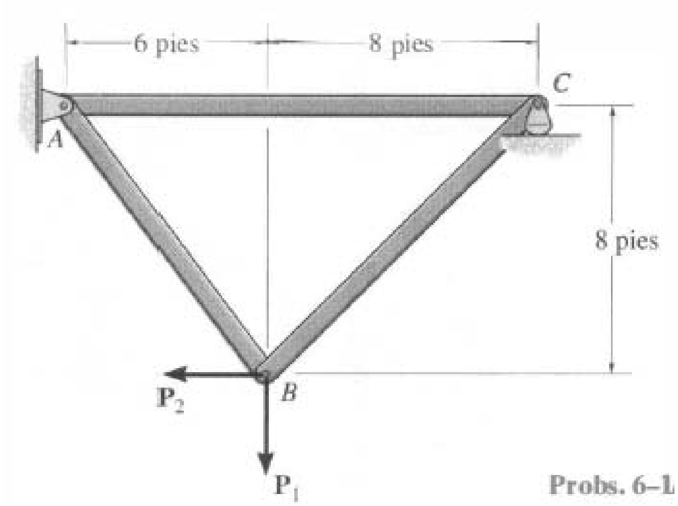
$$\frac{T_{CA}}{\cancel{8}} = \frac{808{,}12}{\cancel{8}\sqrt{2}}$$

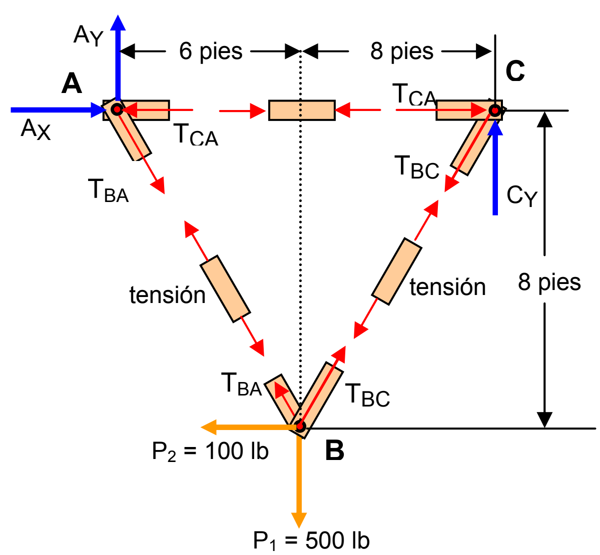
$$T_{CA} = \frac{808{,}12}{\sqrt{2}} = 571{,}42 \text{ lb}$$

T_{CA} = 571,42 lb (Compresión)

Problema 6.2 Estática Hibbeler edic 10

Determine la fuerza en cada miembro de la armadura y establezca si los miembros están en tensión o en compresión. Considere P_1 = 500 lb. y P_2 = 100 lb.





$\Sigma M_A = 0$

$- 100\ (8)\ - 500\ (6) + C_Y\ (6 + 8) = 0$

$- 100\ (8)\ - 500\ (6) + C_Y\ (14) = 0$

$- 800\ - 3000 + C_Y\ (14) = 0$

$- 3800\ + C_Y\ (14) = 0$

$C_Y\ (14) = 3800$

$$C_Y = \frac{3800}{14} = 271{,}42\ \text{lb}$$

C_Y = 271,42 lb

$\sum F_X = 0$

$A_X - 400 = 0$

A_X = 400 lb.

$\Sigma M_C = 0$

$- A_Y\ (6 + 8) - 100\ (8)\ + 500\ (8) = 0$

$- A_Y\ (14) - 100\ (8)\ + 500\ (8) = 0$

$- A_Y\ (14) - 800 + 4000 = 0$

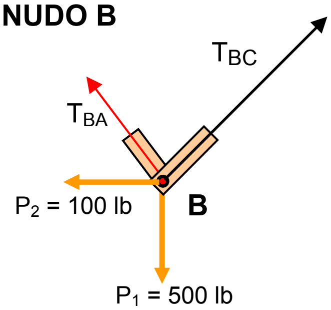
$- 14\ A_Y + 3200 = 0$

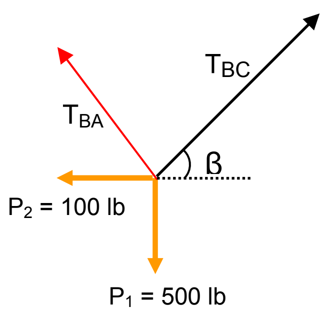
$14\ A_Y = 3200$

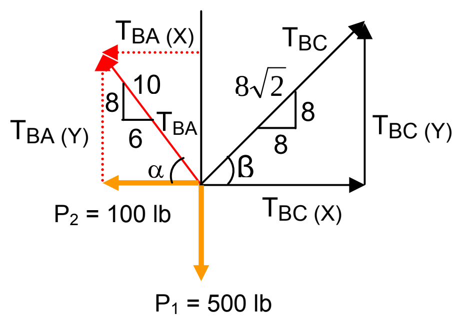
$$A_Y = \frac{3200}{14} = 228{,}57\ \text{lb}$$

A_Y = 228,57 lb

NUDO B







$$\text{sen}\ \alpha = \frac{8}{10} = \frac{4}{5}$$

$$\cos \alpha = \frac{6}{10} = \frac{3}{5}$$

$$\text{sen}\ \beta = \frac{8}{8\sqrt{2}} = \frac{\sqrt{2}}{2}$$

$$\cos \beta = \frac{8}{8\sqrt{2}} = \frac{\sqrt{2}}{2}$$

$$\text{sen}\ \alpha = \frac{T_{BA(Y)}}{T_{BA}} \Rightarrow T_{BA(Y)} = \text{sen}\alpha\,(T_{BA})$$

$$T_{BA(Y)} = \left(\frac{4}{5}\right)(T_{BA})$$

$$\cos\alpha = \frac{T_{BA(X)}}{T_{BA}} \Rightarrow T_{BA(X)} = \cos\alpha\,(T_{BA})$$

$$T_{BA(X)} = \left(\frac{3}{5}\right)(T_{BA})$$

$\sum F_X = 0$

$- 100 + T_{BC\,(X)} - T_{BA\,(X)} = 0$

$T_{BC\,(X)} - T_{BA\,(X)} = 100$

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}T_{BA} = 100 \quad \textbf{(Ecuación 1)}$$

$\sum F_Y = 0$

$- 500 + T_{BC\,(Y)} + T_{BA\,(Y)} = 0$

$T_{BC\,(Y)} + T_{BA\,(Y)} = 500$

$$\frac{\sqrt{2}}{2}(T_{BC}) + \frac{4}{5}T_{BA} = 500 \quad \textbf{(Ecuación 2)}$$

resolver ecuación 1 y ecuación 2

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}T_{BA} = 100 \quad \textbf{(-1)}$$

$$\frac{\sqrt{2}}{2}(T_{BC}) + \frac{4}{5}T_{BA} = 500$$

$$\cancel{-\frac{\sqrt{2}}{2}(T_{BC})} + \frac{3}{5}T_{BA} = -100$$

$$\cancel{\frac{\sqrt{2}}{2}(T_{BC})} + \frac{4}{5}T_{BA} = 500$$

$$\frac{7}{5}T_{BA} = 400$$

$$\text{sen}\ \beta = \frac{T_{BC(Y)}}{T_{BC}} \Rightarrow T_{BC(Y)} = \text{sen}\beta\,(T_{BC})$$

$$T_{BC(Y)} = \left(\frac{\sqrt{2}}{2}\right)(T_{BC})$$

$$\cos\beta = \frac{T_{BC(X)}}{T_{BC}} \Rightarrow T_{BC(X)} = \cos\beta\,(T_{BC})$$

$$T_{BC(X)} = \left(\frac{\sqrt{2}}{2}\right)(T_{BC})$$

Reemplazando en la ecuación 1

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}T_{BA} = 100 \quad \textbf{(Ecuación 1)}$$

$$\frac{\sqrt{2}}{2}(T_{BC}) - \frac{3}{5}(285{,}71) = 100$$

$$\frac{\sqrt{2}}{2}(T_{BC}) - 171{,}42 = 100$$

$$\frac{\sqrt{2}}{2}(T_{BC}) = 271{,}42$$

$$T_{BC} = \left(\frac{2}{\sqrt{2}}\right)271{,}42$$

T_{BC} = 383,84 lb. (Tensión)

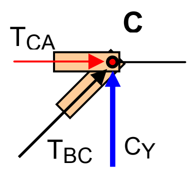
$$T_{BA} = \frac{(400)5}{7}$$

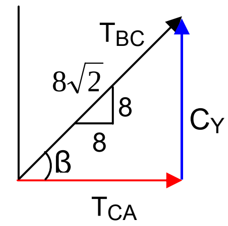
T_{BA} = 285,71 lb. (Tensión)

NUDO C

Las ecuaciones de equilibrio para el nudo C son:

$$\frac{T_{CA}}{8} = \frac{T_{BC}}{8\sqrt{2}} = \frac{C_Y}{8}$$





Hallar T_{CA}

$$\frac{T_{CA}}{8} = \frac{T_{BC}}{8\sqrt{2}}$$

Pero:

T_{BC} = 383,84 lb.

$$\frac{T_{CA}}{\cancel{8}} = \frac{383,84}{\cancel{8}\sqrt{2}}$$

$$T_{CA} = \frac{383,84}{\sqrt{2}} = 271,42 \text{ lb}$$

T_{CA} = 271,42 lb (Compresión)

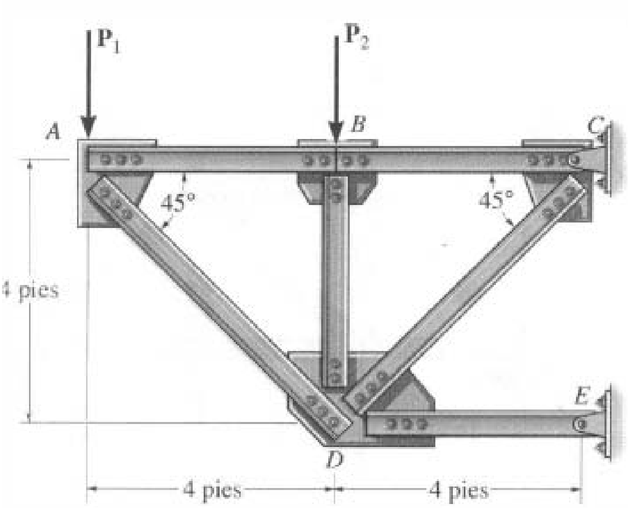
T_{BA} = 285,71 lb. (Tensión)

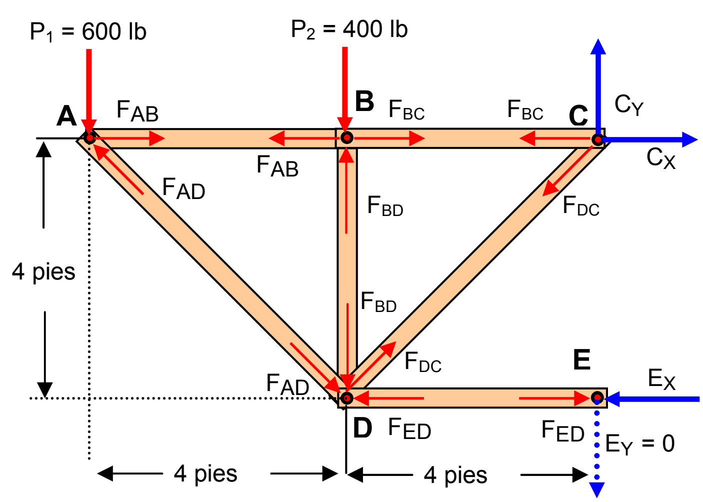
T_{BC} = 383,84 lb. (Tensión)

T_{CA} = 271,42 lb (Compresión)

Problema 6.3 Estática Hibbeler edic 10

La armadura, usada para soportar un balcón, esta sometida a la carga mostrada. Aproxime cada nudo como un pasador y determine la fuerza en cada miembro. Establezca si los miembros están en tensión o en compresión. Considere P_1 = 600 lb P_2 = 400 lb.





$\Sigma M_C = 0$

$+$ $P_1 (4 + 4) + P_2 (4) - E_X (4) = 0$

$600\,(4 + 4) + 400\,(4) - E_X\,(4) = 0$

$600\,(8) + 400\,(4) - 4\,E_X = 0$

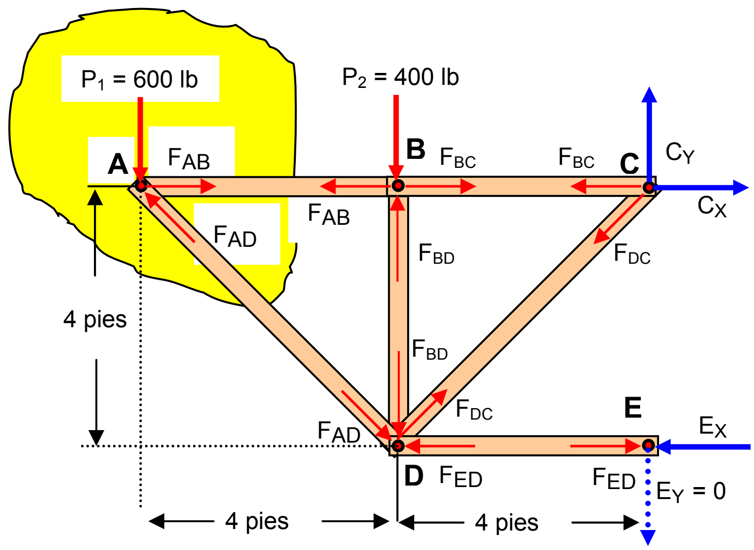
$4800 + 1600 - 4\,E_X = 0$

$6400 - 4\,E_X = 0$

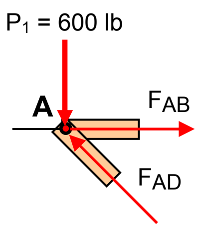
$4\,E_X = 6400$

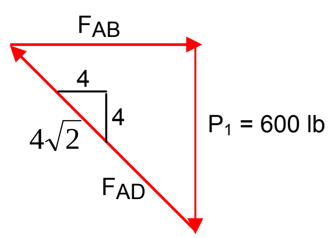
$$E_X = \frac{6400}{4} = 1600\ \text{lb}$$

E_X = 1600 lb



NUDO A





Las ecuaciones de equilibrio para el nudo A son:

$$\frac{F_{AB}}{\cancel{4}} = \frac{F_{AD}}{\cancel{4}\sqrt{2}} = \frac{600}{\cancel{4}}$$

Cancelar términos semejantes

$$F_{AB} = \frac{F_{AD}}{\sqrt{2}} = 600$$

Hallar F_{AB}

$$F_{AB} = 600\ \text{lb}$$

F_{AB} = 600 lb (Tension)

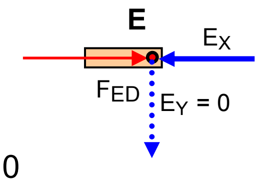
Hallar F_{AD}

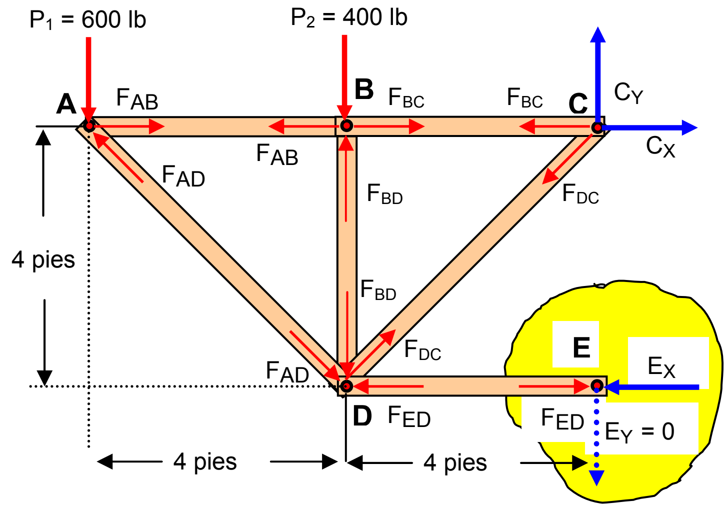
$$\frac{F_{AD}}{\sqrt{2}} = 600$$

$$F_{AD} = \left(\sqrt{2}\right)600 = 848{,}52\ \text{lb}$$

F_{AD} = 848,52 lb (compresión)

NUDO E





$\Sigma F_X = 0$
$F_{ED} - E_X = 0$

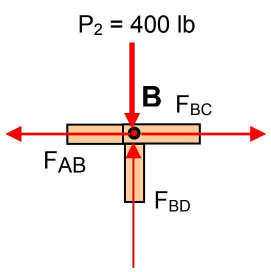
$F_{ED} = E_X$

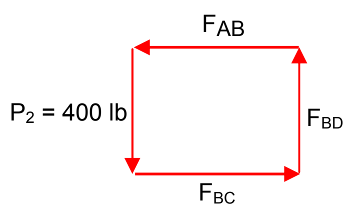
PERO: **E_X = 1600 lb**

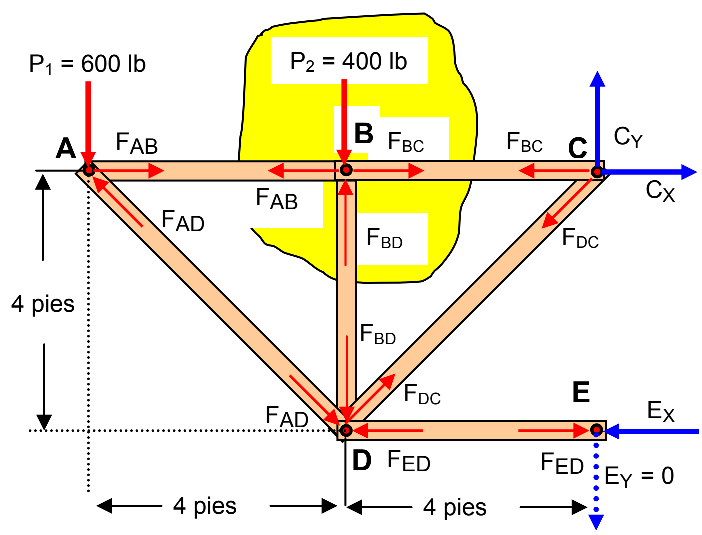
F_{ED} = 1600 lb (compresión)

$\Sigma F_Y = 0$
E_Y = 0

NUDO B







$\Sigma F_X = 0$
$F_{BC} - F_{AB} = 0$

$F_{BC} = F_{AB}$

PERO: **F_{AB} = 600 lb (Tensión)**

F_{BC} = 600 lb (Tensión)
$\Sigma F_Y = 0$

$F_{BD} - 400 = 0$

F_{BD} = 400 lb (compresión)

$\Sigma F_Y = 0$

$C_Y - 600 - 400 = 0$

$C_Y - 1000 = 0$

C_Y = 1000 lb.

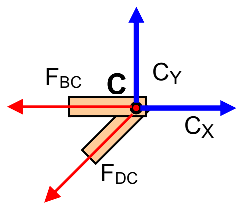
$\Sigma F_X = 0$
$C_X - E_X = 0$
$C_X = E_X$

PERO: **E_X = 1600 lb**

C_X = 1600 lb

NUDO C

$\Sigma F_Y = 0$

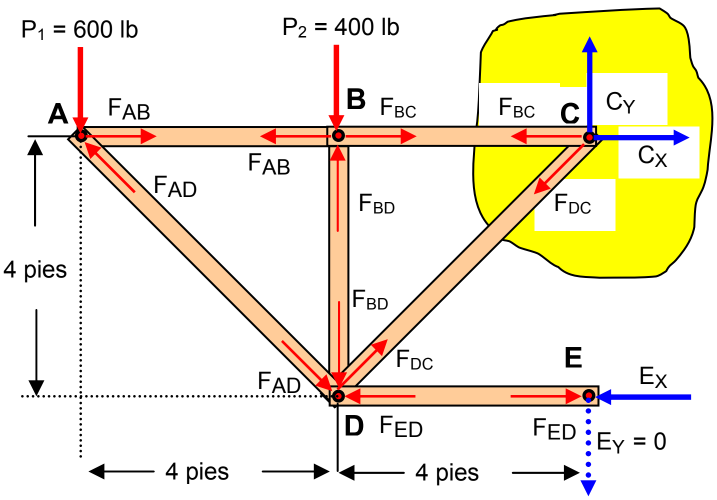


$C_Y - F_{DC(Y)} = 0$

$C_Y = F_{DC(Y)}$

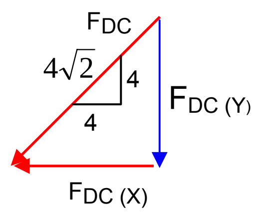
PERO: **C_Y = 1000 lb.**

$F_{DC(Y)} = 1000$ lb

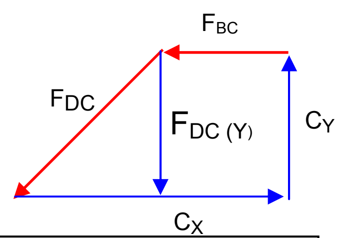


$$\operatorname{sen}\alpha = \frac{4}{4\sqrt{2}} = \frac{1}{\sqrt{2}} = 0{,}7071$$

$$\operatorname{sen}\alpha = \frac{F_{DC(Y)}}{F_{DC}}$$



$$F_{DC} = \frac{F_{DC(Y)}}{\operatorname{sen}\alpha}$$



$$F_{DC} = \frac{1000}{0{,}7071} = 1414{,}22 \text{ lb}$$

F_{DC} = 1414,22 lb (tensión)

E_X = 1600 lb

E_Y = 0

C_X = 1600 lb

C_Y = 1000 lb.

F_{BD} = 400 lb (compresión)

F_{BC} = 600 lb (Tensión)

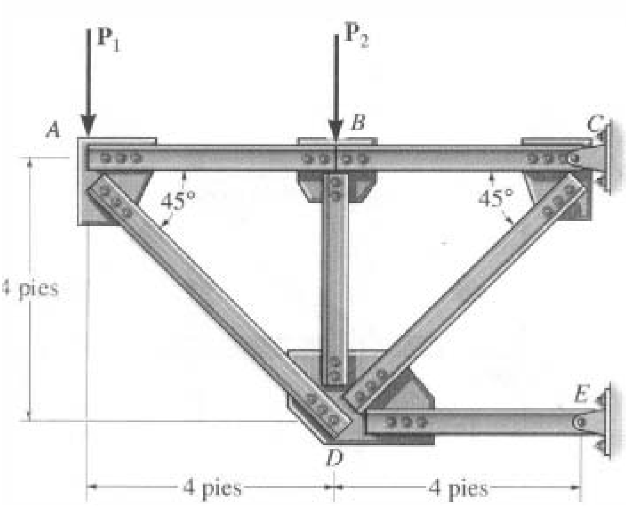
F_{AB} = 600 lb (Tensión)

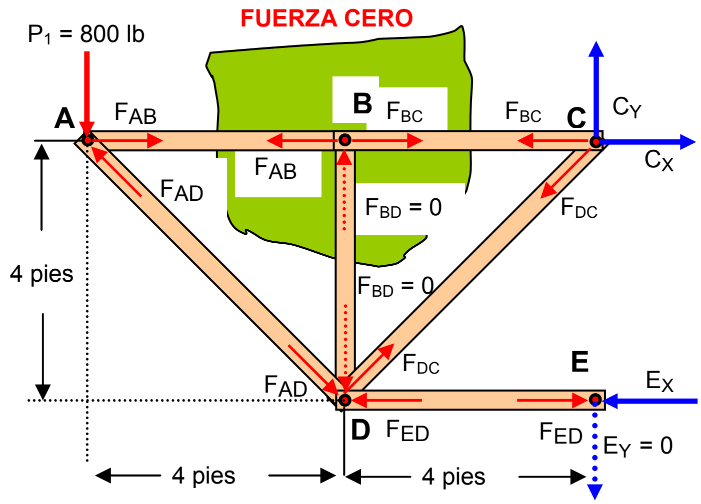
F_{ED} = 1600 lb (compresión)

F_{AD} = 848,52 lb (compresión)

F_{DC} = 1414,22 lb (tensión)

Problema 6.4 Estática Hibbeler edic 10
La armadura, usada para soportar un balcón, esta sometida a la carga mostrada. Aproxime cada nudo como un pasador y determine la fuerza en cada miembro. Establezca si los miembros están en tensión o en compresión. Considere P_1 = 800 lb P_2 = 0 lb.





$\Sigma M_C = 0$

$P_1\,(4 + 4) - E_X\,(4) = 0$

$800\,(4 + 4) - E_X\,(4) = 0$

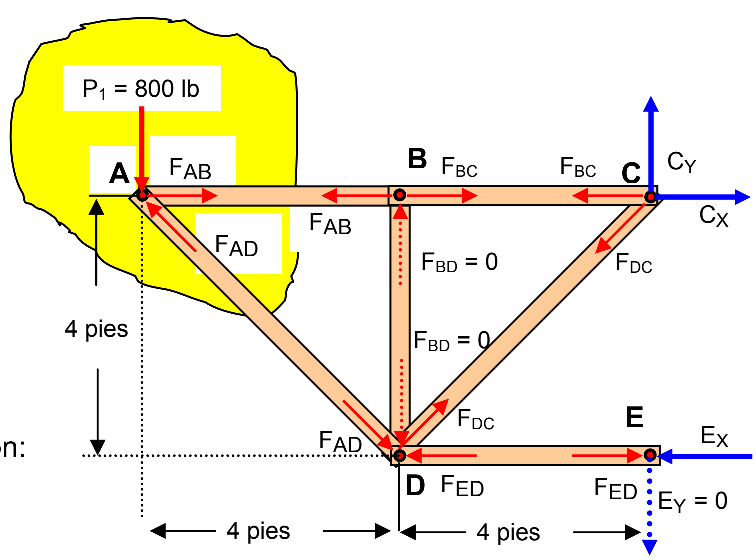
$800\,(8) - 4\,E_X = 0$

$6400 - 4\,E_X = 0$

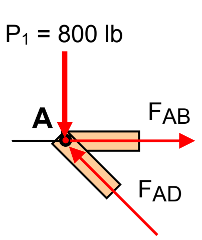
$4\,E_X = 6400$

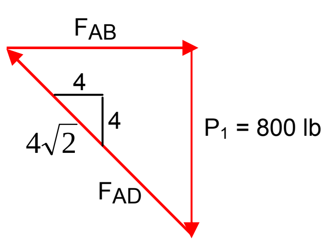
$$E_X = \frac{6400}{4} = 1600 \text{ lb}$$

E_X = 1600 lb



NUDO A





Las ecuaciones de equilibrio para el nudo A son:

$$\frac{F_{AB}}{4} = \frac{F_{AD}}{4\sqrt{2}} = \frac{800}{4}$$

Cancelar términos semejantes

$$F_{AB} = \frac{F_{AD}}{\sqrt{2}} = 800$$

Hallar F_{AB}

$$F_{AB} = 800 \text{ lb}$$

F_{AB} = 800 lb (Tensión)

Hallar F_{AD}

$$\frac{F_{AD}}{\sqrt{2}} = 800$$

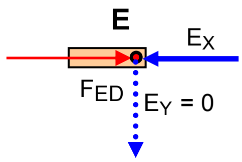
$$F_{AD} = \left(\sqrt{2}\right)800 = 1131{,}37 \text{ lb}$$

F_{AD} = 1131,37 lb (compresión)

NUDO E

$\Sigma F_X = 0$

$F_{ED} - E_X = 0$



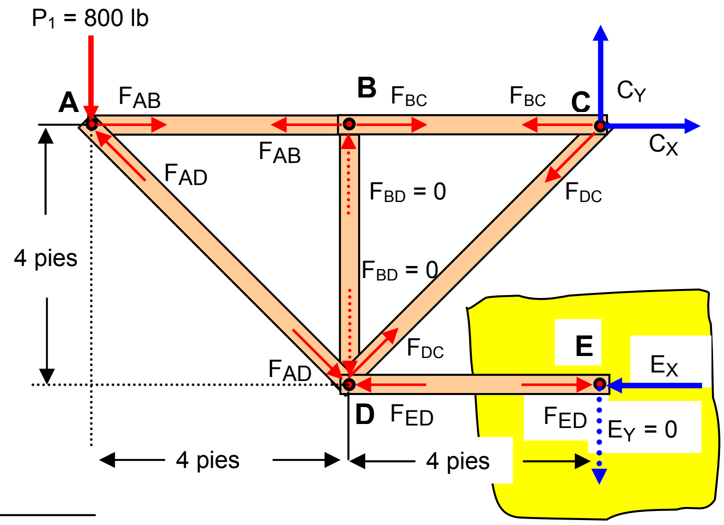
$F_{ED} = E_X$

PERO: **E_X = 1600 lb**

F_{ED} = 1600 lb (compresión)

$\Sigma F_Y = 0$

$E_Y = 0$



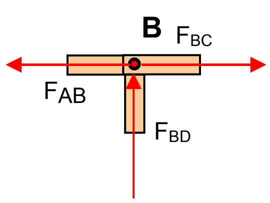
NUDO B

FUERZA CERO

Si tres miembros forman un nudo de armadura en el cual dos de los miembros son colineales, el tercer miembro es un miembro de fuerza cero siempre que **ninguna** fuerza exterior o reacción de soporte este aplicada al nudo.

$\Sigma F_X = 0$

$F_{BC} - F_{AB} = 0$



$F_{BC} = F_{AB}$

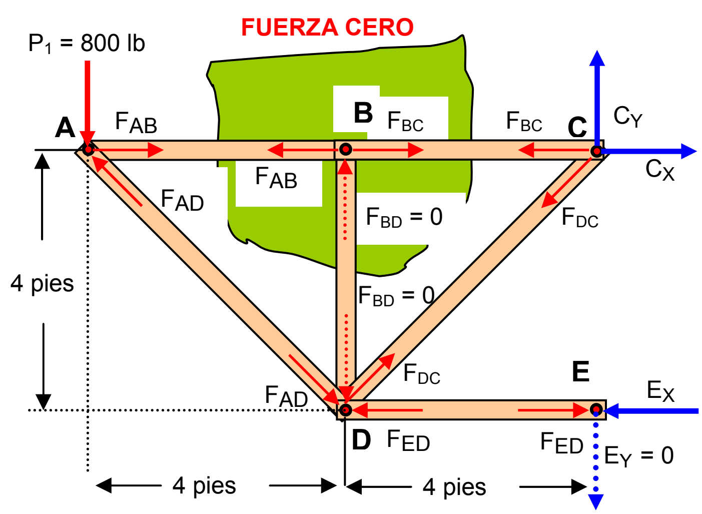
Pero:

F_{AB} = 800 lb (Tensión)

F_{BC} = 800 lb (Tensión)

$\Sigma F_Y = 0$

$F_{BD} = 0$



$\Sigma F_Y = 0$

$C_Y - 800 = 0$

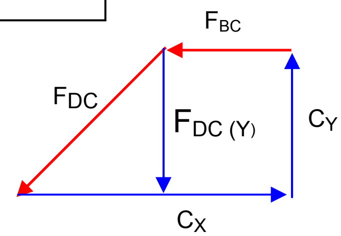
C_Y = 800 lb.

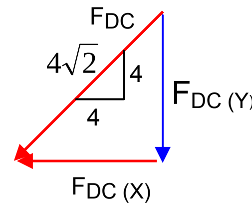
$\Sigma F_X = 0 \qquad C_X - E_X = 0$

$C_X = E_X$

PERO: **E_X = 1600 lb**

C_X = 1600 lb



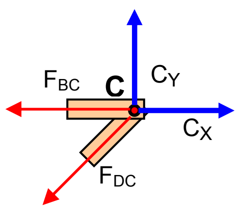


NUDO C

$\Sigma F_Y = 0$

$C_Y - F_{DC(Y)} = 0$

$C_Y = F_{DC(Y)}$



PERO: **C_Y = 800 lb.**

$F_{DC(Y)} = 800$ lb

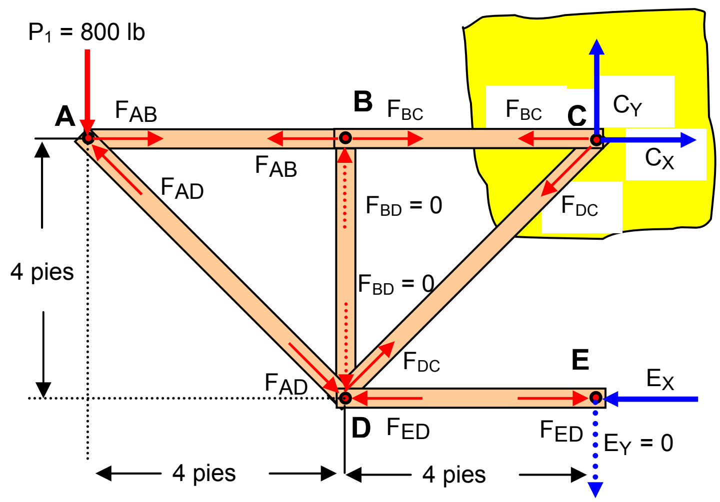
$$\text{sen}\,\alpha = \frac{4}{4\sqrt{2}} = \frac{1}{\sqrt{2}} = 0{,}7071$$

$$\text{sen}\,\alpha = \frac{F_{DC(Y)}}{F_{DC}}$$

$$F_{DC} = \frac{F_{DC(Y)}}{\text{sen}\,\alpha}$$

$$F_{DC} = \frac{800}{0{,}7071} = 1131{,}38\ \text{lb}$$

F_{DC} = 1131,38 lb (tensión)



E_X = 1600 lb   **E_Y = 0**

C_X = 1600 lb

C_Y = 800 lb.

F_{BD} = 0 lb

F_{BC} = 800 lb (Tensión)

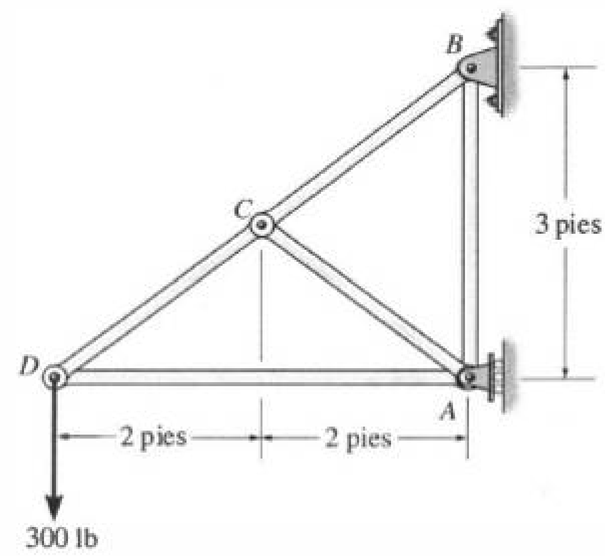
F_{AB} = 800 lb (Tensión)

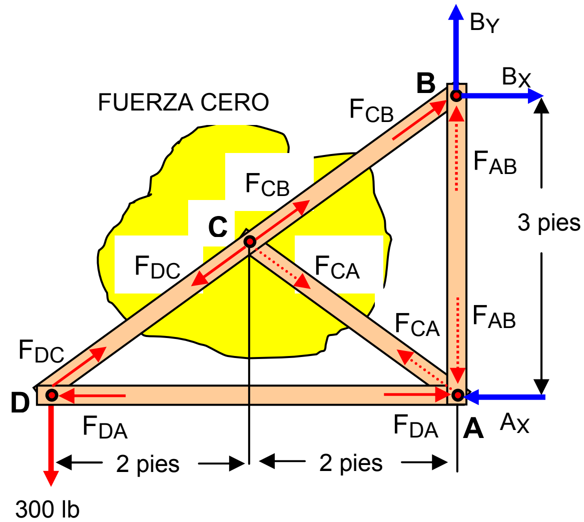
F_{ED} = 1600 lb (compresión)

F_{AD} = 1131,37 lb (compresión)

F_{DC} = 1131,38 lb (tensión)

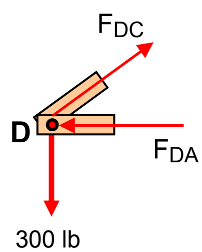
Problema c-34 estática Hibbeler edic 10
Determine la fuerza en cada miembro de la armadura. Establezca si los miembros están en tensión o en compresión.

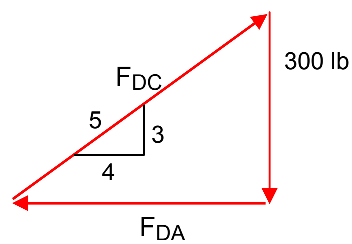




NUDO D

$$\frac{F_{DC}}{5} = \frac{300}{3} = \frac{F_{DA}}{4}$$





$$\frac{F_{DC}}{5} = 100 = \frac{F_{DA}}{4}$$

Hallar F_{DA}

$$\frac{F_{DA}}{4} = 100$$

F_{DA} = (4) 100 = 400 lb (compresión)

Hallar F_{CD}

$$\frac{F_{DC}}{5} = 100$$

F_{DC} = (5) 100 = 500 lb (Tensión)

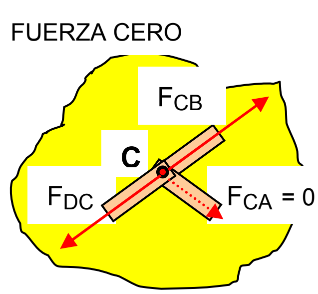
FUERZA CERO
Si tres miembros forman un nudo de armadura en el cual dos de los miembros son colineales, el tercer miembro es un miembro de fuerza cero siempre que ninguna fuerza exterior o reacción de soporte este aplicada al nudo.

F_{CA} = 0

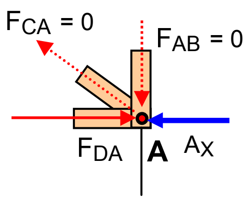
F_{DC} = F_{CB}

Pero: F_{DC} = 500 lb

F_{CB} = 500 lb (Tensión)



NUDO A



$\sum F_X = 0$

$F_{DA} - A_X = 0$

$\sum F_Y = 0$

$F_{AB} = 0$

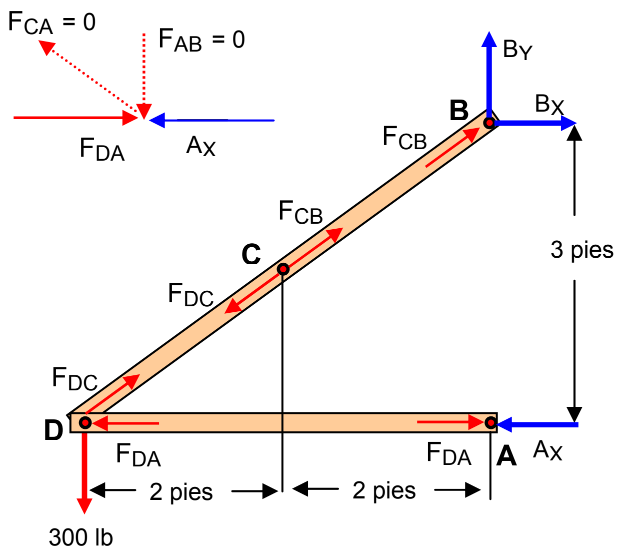
$F_{CA} = 0$

$F_{AB} = 0$

$F_{CB} = 500$ lb (Tensión)

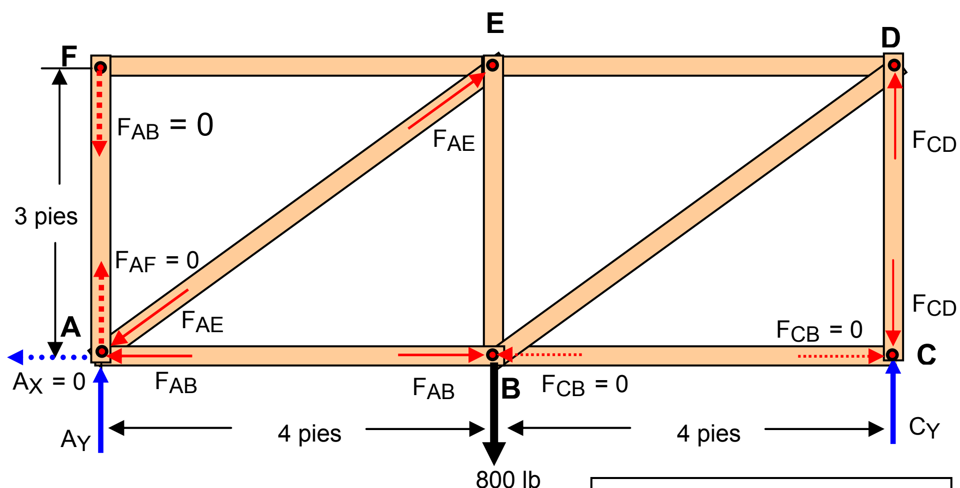
$F_{DA} = (4)\ 100 = 400$ lb (compresión)

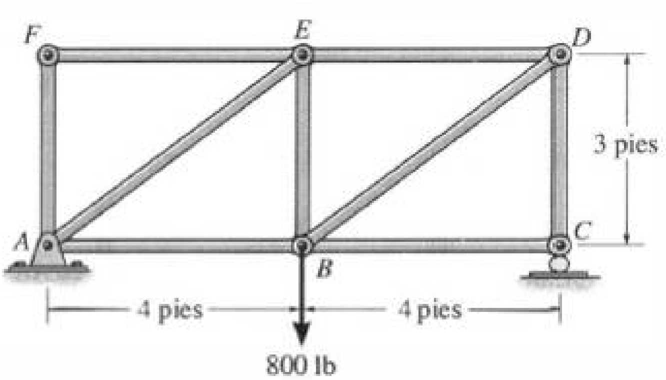
$F_{DC} = (5)\ 100 = 500$ lb (Tensión)



Problema C-35 estática Hibbeler edic 10

Determine la fuerza en los miembros AE y DC. Establezca si los miembros están en tensión o en compresión.





$\sum F_Y = 0$

$A_Y - 800 + C_Y = 0$

Pero: $C_Y = 400$ lb

$A_Y - 800 + 400 = 0$

$A_Y - 400 = 0$

$A_Y = 400$ lb

$\Sigma M_A = 0$

$- 800\ (4\ ) + C_Y\ (4 + 4) = 0$

$- 3200 + C_Y\ (8) = 0$

$C_Y\ (8) = 3200$

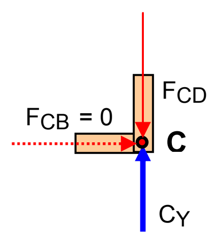
$$C_Y = \frac{3200}{8} = 400\,\text{lb}$$

C_Y = 400 lb

$\sum F_X = 0$

A_X = 0

NUDO C



$\sum F_Y = 0$

$C_Y - F_{CD} = 0$

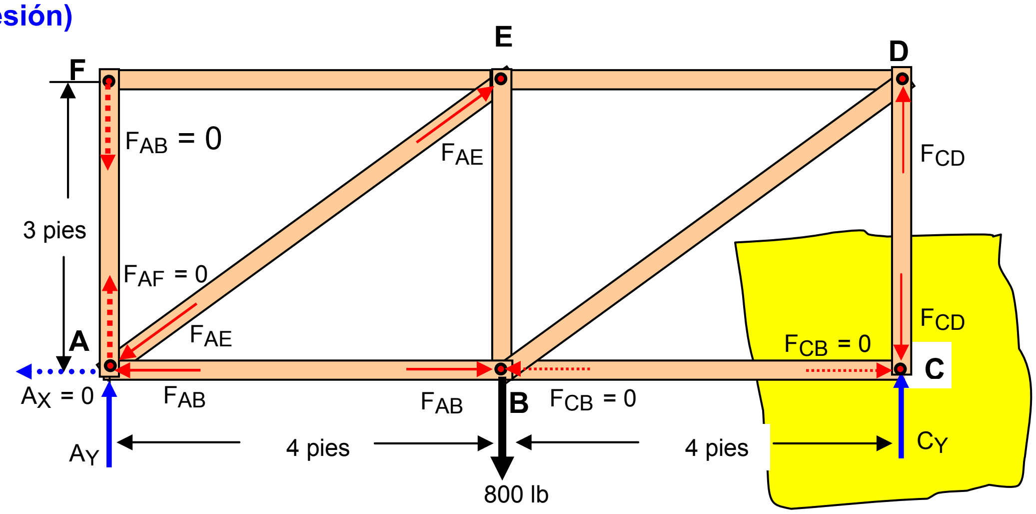
Pero: C_Y = 400 lb

$C_Y = F_{CD}$

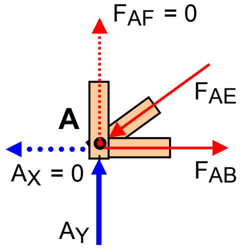
F_{CD} = 400 lb (compresión)

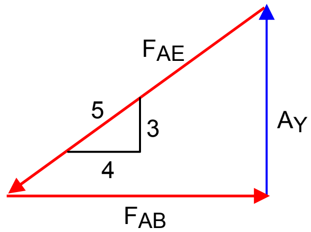
$\sum F_X = 0$

F_{CB} = 0



NUDO A

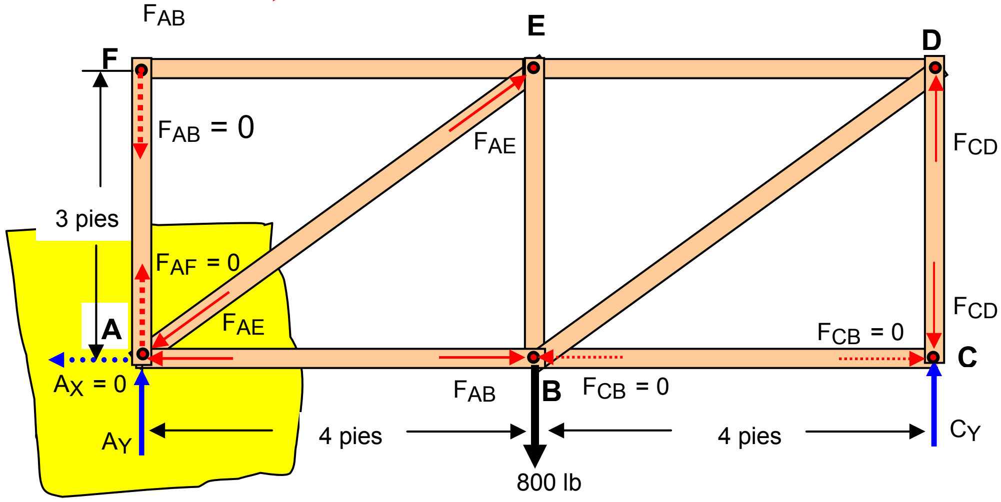




$$\frac{F_{AE}}{5}=\frac{A_Y}{3}=\frac{F_{AB}}{4}$$

Pero: **A_Y = 400 lb**

$$\frac{F_{AE}}{5}=\frac{400}{3}=\frac{F_{AB}}{4}$$



Hallar F_{AE}

$$\frac{F_{AE}}{5}=\frac{400}{3}$$

$$F_{AE}=\frac{400(5)}{3}$$

F_{AE} = 666,66 lb (compresión)

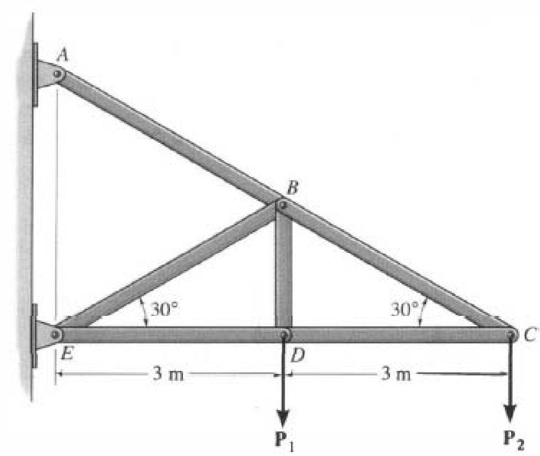
Hallar F_{CD}

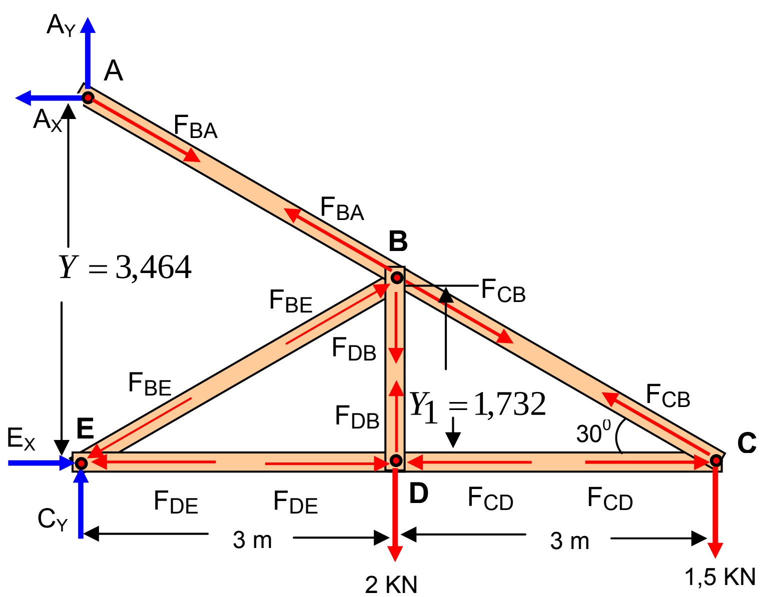
$$\frac{F_{AB}}{4}=\frac{400}{3}$$

F_{AB} = 533,33 lb (Tensión)

Problema 6.8 estática Hibbeler edic 10

Determine la fuerza en cada miembro de la armadura y establezca si los miembros están a tensión o en compresión. Considere P_1 = 2 KN y P_2 = 1,5 kN.





$\Sigma M_E = 0$

$+ \quad - 2\,(3) - 1{,}5\,(3 + 3) + A_X\,(3{,}464) = 0$

$- 6 - 1{,}5\,(6) + 3{,}464\, A_X = 0$

$- 6 - 9 + 3{,}464\, A_X = 0$

$- 15 + 3{,}464\, A_X = 0$

$3{,}464\, A_X = 15$

$$A_X = \frac{15}{3{,}464} = 4{,}33\ \text{kN}$$

A_X = 500 N

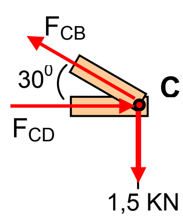
$$\text{tg } 30 = \frac{Y}{6}$$

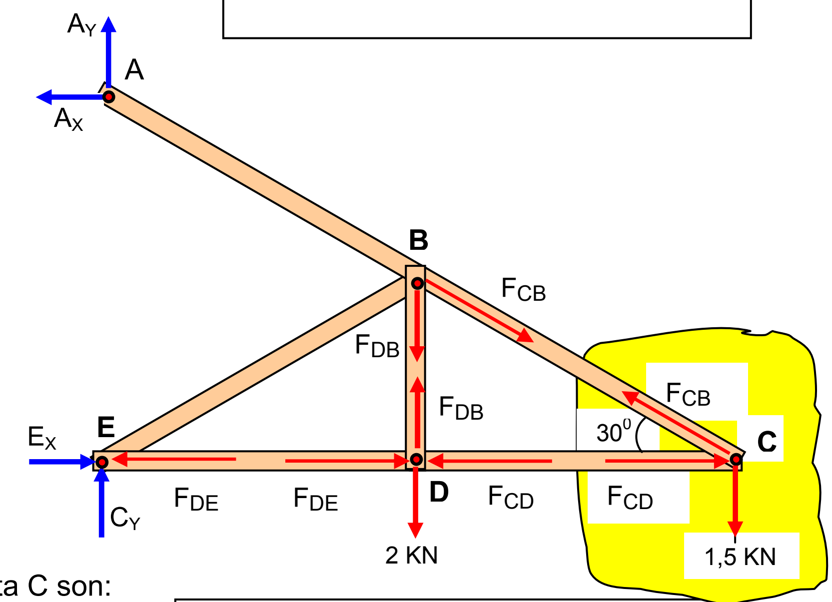
Y = 6 tg 30 = 6 (0,5773) = 3,464 m

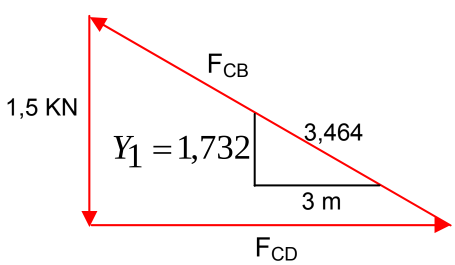
$$\text{tg } 30 = \frac{Y_1}{3}$$

Y_1 = 3 tg 30 = 3 (0,5773) = 1,732 m

NUDO C







Las ecuaciones de equilibrio para la junta C son:

$$\frac{F_{CB}}{3{,}464} = \frac{1{,}5}{1{,}732} = \frac{F_{CD}}{3}$$

Hallar F_{CB}

$$\frac{F_{CB}}{3{,}464} = \frac{1{,}5}{1{,}732}$$

$$F_{CB} = \frac{1{,}5\,(3{,}464)}{1{,}732} = 3\ \text{kN}$$

F_{CB} = 3 kN (tensión)

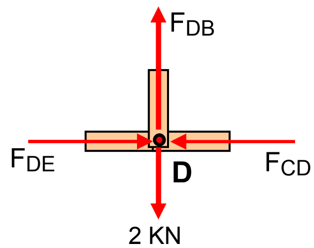
Hallar F_{CD}

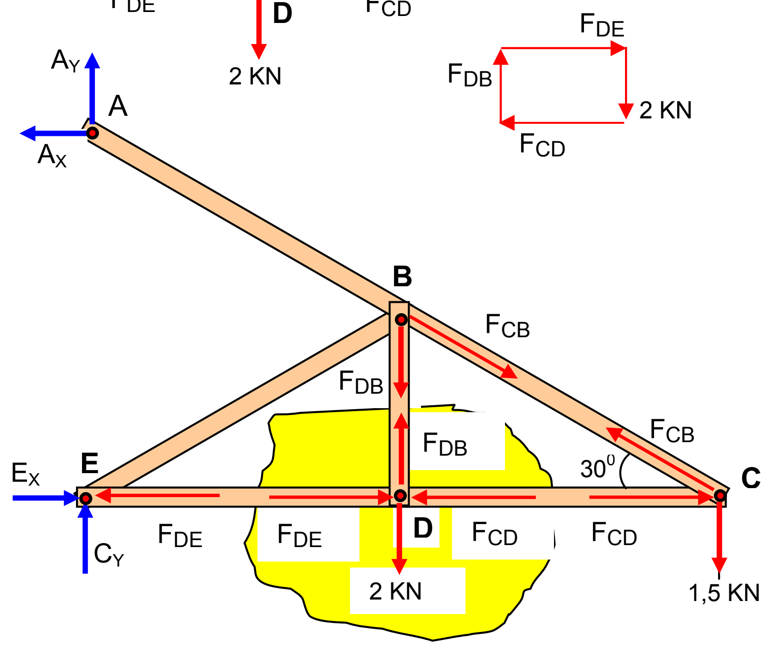
$$\frac{1{,}5}{1{,}732} = \frac{F_{CD}}{3}$$

$$F_{CD} = \frac{1{,}5\,(3)}{1{,}732} = 2{,}598\ \text{kN}$$

F_{CD} = 2,598 kN (compresión)

NUDO D





$\sum F_X = 0$

$F_{DE} - F_{CD} = 0$

$F_{DE} = F_{CD}$

Pero: F_{CD} = 2,598 kN (compresión)

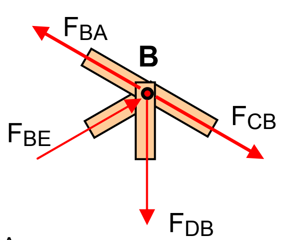
F_{DE} = 2,598 kN (compresión)

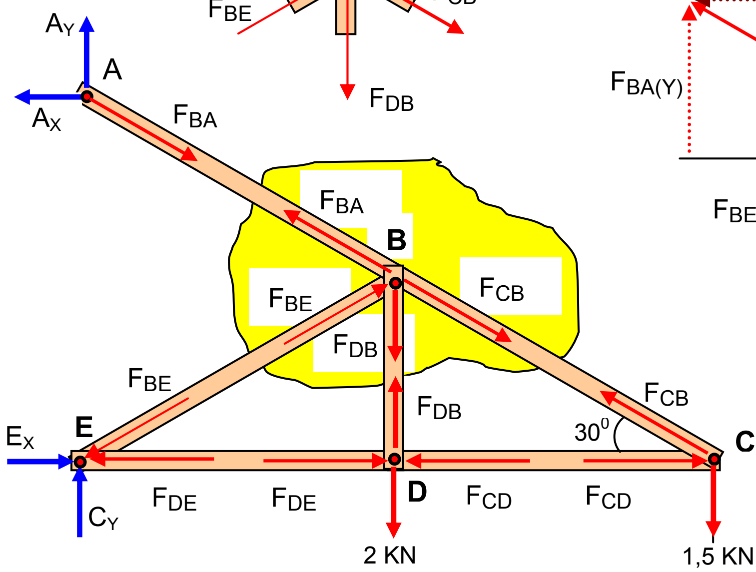
$\sum F_Y = 0$

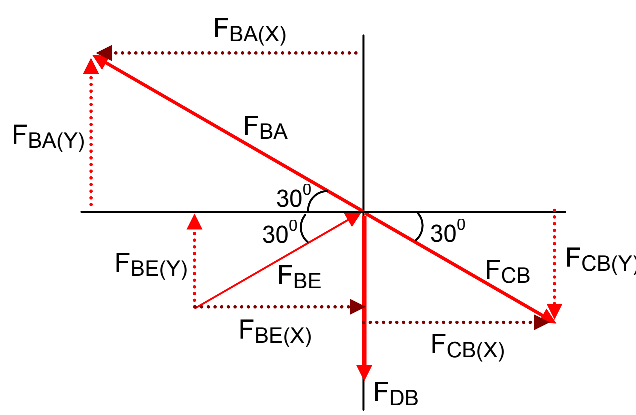
$F_{DB} - 2 = 0$

F_{DB} = 2 kN (tensión)

NUDO B







$$\text{sen } 30 = \frac{F_{BA(Y)}}{F_{BA}}$$

$F_{BA(Y)} = F_{BA}$ sen 30

$$F_{BA(Y)} = F_{BA}\left(\frac{1}{2}\right)$$

Para abreviar los cálculos

$$\text{sen } 30 = \frac{\sqrt{3}}{2} \qquad \text{sen } 60 = \frac{1}{2}$$

$$\text{sen } 30 = \frac{F_{BE(Y)}}{F_{BE}}$$

$F_{BE\ (Y)}$ = F_{BE} sen 30

$$F_{BE(Y)} = F_{BE}\left(\frac{1}{2}\right)$$

$$\text{sen } 30 = \frac{F_{CB(Y)}}{F_{CB}}$$

$F_{CB\ (Y)}$ = F_{CB} sen 30

$$F_{CB(Y)} = F_{CB}\left(\frac{1}{2}\right)$$

$$\cos 30 = \frac{F_{BA(X)}}{F_{BA}}$$

$F_{BA\ (X)}$ = F_{BA} cos 30

$$F_{BA(X)} = F_{BA}\left(\frac{\sqrt{3}}{2}\right)$$

$$\cos 30 = \frac{F_{BE(X)}}{F_{BE}}$$

$F_{BE\ (X)}$ = F_{BE} cos 30

$$F_{BE(X)} = F_{BE}\left(\frac{\sqrt{3}}{2}\right)$$

$$\cos 30 = \frac{F_{CB(X)}}{F_{CB}}$$

$F_{CB\ (X)}$ = F_{CB} cos 30

$$F_{CB(X)} = F_{CB}\left(\frac{\sqrt{3}}{2}\right)$$

$\sum F_Y = 0$

$F_{BA\ (Y)} + F_{BE\ (Y)} - F_{CB\ (Y)} - F_{DB} = 0$

$$\left(\frac{1}{2}\right)F_{BA} + \left(\frac{1}{2}\right)F_{BE} - \left(\frac{1}{2}\right)F_{CB} - F_{DB} = 0$$

Pero:

F_{DB} = 2 kN (tensión)

F_{CB} = 3 kN (tensión)

$$\left(\frac{1}{2}\right)F_{BA} + \left(\frac{1}{2}\right)F_{BE} - \left(\frac{1}{2}\right)(3) - 2 = 0$$

$$\left(\frac{1}{2}\right)F_{BA} + \left(\frac{1}{2}\right)F_{BE} = \left(\frac{1}{2}\right)(3) + 2$$

$$\left(\frac{1}{2}\right)F_{BA} + \left(\frac{1}{2}\right)F_{BE} = 1{,}5 + 2 = 3{,}5$$

0,5 F_{BA} + 0,5 F_{BE} = 3,5 dividiendo por 0,5 (para simplificar)

$F_{BA} + F_{BE}$ = 7 (Ecuación 1)

$\sum F_X = 0$

$- F_{BA\ (X)} + F_{BE\ (X)} + F_{CB\ (X)} = 0$

$$-\cancel{\left(\frac{\sqrt{3}}{2}\right)}F_{BA} + \cancel{\left(\frac{\sqrt{3}}{2}\right)}F_{BE} + \cancel{\left(\frac{\sqrt{3}}{2}\right)}F_{CB} = 0$$

$- F_{BA} + F_{BE} + F_{CB} = 0$

Pero:

F_{CB} = 3 kN (tensión)

$- F_{BA} + F_{BE} + 3 = 0$

$- F_{BA} + F_{BE} = - 3 \quad (- 1)$

$F_{BA} - F_{BE} = 3$ (Ecuación 2)

Resolver la ecuación 1 y 2

$F_{BA} + \cancel{F_{BE}} = 7$ (Ecuación 1)

$F_{BA} - \cancel{F_{BE}} = 3$ (Ecuación 2)

$2 F_{BA} = 10$

$$F_{BA} = \frac{10}{2} = 5 \text{ kN}$$

F_{BA} = 5 kN (tensión)

Reemplazando en la ecuación 1

$F_{BA} + F_{BE} = 7$ (Ecuación 1)

Pero: F_{BA} = 5 kN (tensión)

$5 + F_{BE} = 7$

$F_{BE} = 7 - 5$

F_{BE} = 2 kN (compresión)

A_X = 500 N F_{CB} = 3 kN (tensión)

F_{CD} = 2,598 kN (compresión)

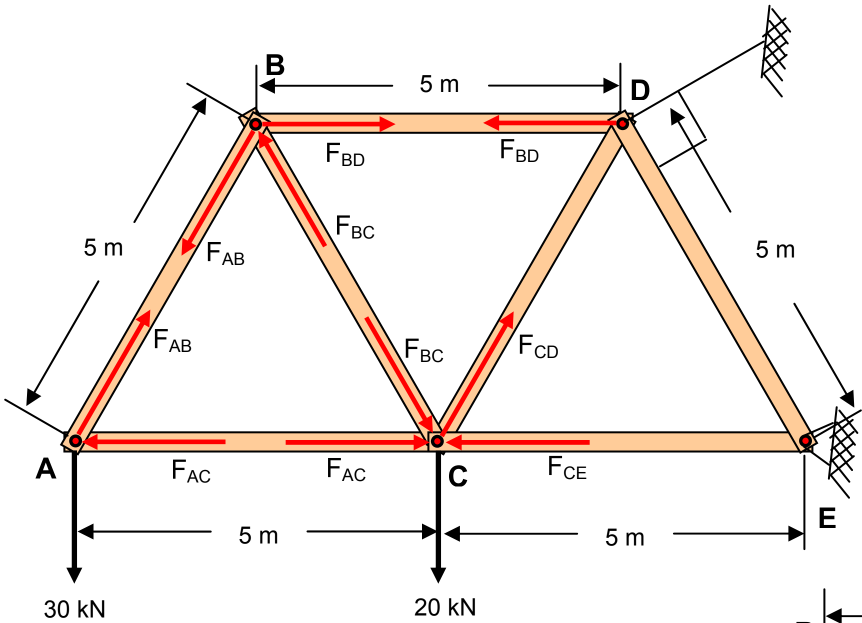
F_{DE} = 2,598 kN (compresión)

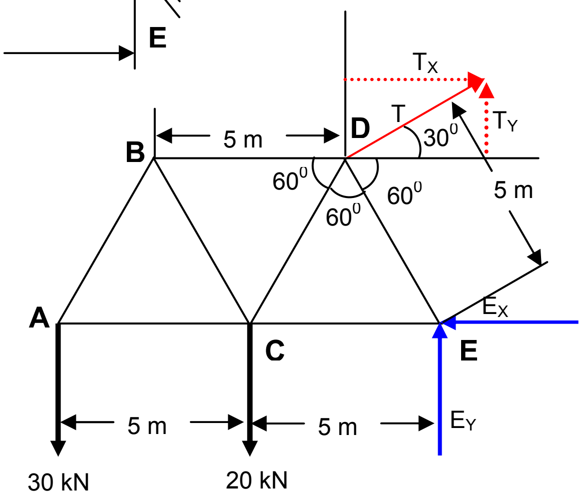
F_{DB} = 2 kN (tensión)

F_{BA} = 5 kN (tensión)

F_{BE} = 2 kN (compresión)

PROBLEMA RESUELTO ESTATICA MERIAM Edic 3.
Calcular, por el método de los nudos, la fuerza en los miembros del entramado en voladizo





Solución. Si no se deseara calcular las reacciones externas en *D* y *E*, el análisis de un entramado en voladizo podría iniciarse en el nudo del extremo en que se aplica la carga. Sin embargo, este entramado lo analizaremos por completo, por lo que el primer paso será calcular las fuerzas exteriores en *D* y *E* empleando el diagrama de sólido libre del entramado en conjunto. Las ecuaciones de equilibrio dan

$\Sigma M_E = 0$

\+ $- T (5) + 30 (5 + 5) + 20 (5) = 0$

$- 5 T + 30 (10) + 20 (5) = 0$

$- 5 T + 300 + 100 = 0$

$- 5 T + 400 = 0$

$5 T = 400$

$$T = \frac{400}{5} = 80\ \text{N}$$

T = 80 N

$$\cos 30 = \frac{T_X}{T}$$

T_X = T cos 30

Pero: T = 80 N

T_X = 80 (0,866)

T_X = 69,28 N

$$\text{sen}\ 30 = \frac{T_Y}{T}$$

T_Y = T sen 30

Pero: T = 80 N

T_Y = 80 (0,5)

T_Y = 40 N

$\sum F_Y = 0$

$T_Y + E_Y - 30 - 20 = 0$

$T_Y + E_Y - 50 = 0$

Pero: T_Y = 40 N

$40 + E_Y - 50 = 0$

$E_Y - 10 = 0$

E_Y = 10 KN

$\sum F_X = 0$

$T_X - E_X = 0$

Pero: T_X = 69,28 N

$T_X = E_X$

E_X = 69,28 N

A continuación, dibujamos los diagramas de sólido libre que muestren las fuerzas actuantes en cada nudo. La exactitud de los sentidos asignados a las fuerzas se comprueba al considerar cada nudo en el orden asignado. No debe haber dudas acerca de la exactitud del sentido asignado a las fuerzas actuantes en el nudo A. El equilibrio exige

NUDO A

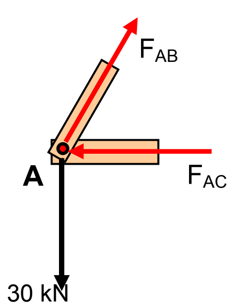
$$\frac{F_{AB}}{5} = \frac{30}{4{,}33} = \frac{F_{AC}}{2{,}5}$$

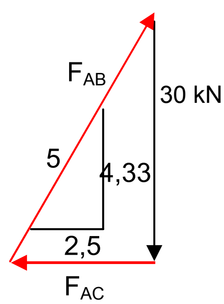
Hallar F_{AB}

$$\frac{F_{AB}}{5} = \frac{30}{4{,}33}$$

$$F_{AB} = \frac{(30)\,5}{4{,}33} = 34{,}64\ \text{KN}$$

F_{AB} = 34,64 kN (tensión)





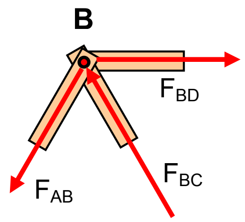
Se halla F_{AC}

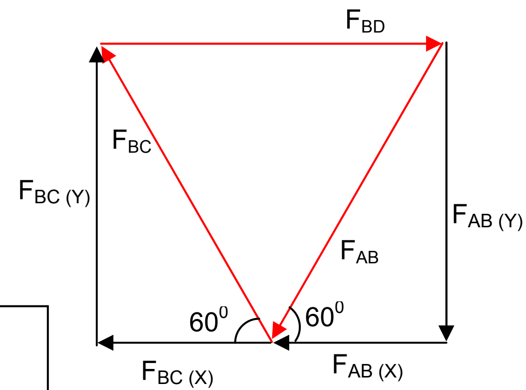
$$\frac{30}{4{,}33} = \frac{F_{AC}}{2{,}5}$$

$$F_{AC} = \frac{(30)\,2{,}5}{4{,}33} = 17{,}32\ \text{KN}$$

F_{AC} = 17,32 kN (compresion)

NUDO B





Para abreviar los cálculos

$$\text{sen } 60 = \frac{\sqrt{3}}{2} \quad \cos 60 = \frac{1}{2}$$

$$\text{sen } 60 = \frac{F_{BC(Y)}}{F_{BC}}$$

$F_{BC(Y)} = F_{BC}$ sen 60

$$F_{BC(Y)} = F_{BC}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{BC(Y)} = \left(\frac{\sqrt{3}}{2}\right)F_{BC}$$

$$\text{sen } 60 = \frac{F_{AB(Y)}}{F_{AB}}$$

$F_{AB(Y)} = F_{AB}$ sen 60

$$F_{AB(Y)} = F_{AB}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{AB(Y)} = \left(\frac{\sqrt{3}}{2}\right)F_{AB}$$

$\sum F_Y = 0$

$F_{BC(Y)} - F_{AB(Y)} = 0$

$F_{BC(Y)} = F_{AB(Y)}$

$$\cancel{\left(\frac{\sqrt{3}}{2}\right)}F_{BC} = \cancel{\left(\frac{\sqrt{3}}{2}\right)}F_{AB}$$

$F_{BC} = F_{AB}$

PERO: F_{AB} = 34,64 kN

F_{BC} = 34,64 kN (compresión)

$$F_{AB(x)} = \left(\frac{1}{2}\right)F_{AB}$$

$$\cos 60 = \frac{F_{AB(X)}}{F_{AB}}$$

$F_{AB(X)} = F_{AB}$ cos 60

$$F_{AB(x)} = F_{AB}\left(\frac{1}{2}\right)$$

$$F_{AB(x)} = \left(\frac{1}{2}\right)F_{AB}$$

$$\cos 60 = \frac{F_{BC(X)}}{F_{BC}}$$

$F_{BC(X)} = F_{BC}$ cos 60

$$F_{BC(x)} = F_{BC}\left(\frac{1}{2}\right)$$

$$F_{BC(x)} = \left(\frac{1}{2}\right)F_{BC}$$

PERO: F_{AB} = 34,64 kN

$$F_{AB}(x) = \left(\frac{1}{2}\right)(34{,}64) = 17{,}32 \text{ KN}$$

$F_{AB(x)}$ = 17,32 KN

$\sum F_X = 0$

$- F_{AB(x)} - F_{BC(x)} + F_{BD} = 0$

PERO:
$F_{AB(x)}$ = 17,32 KN
$F_{BC(x)}$ = 17,32 KN

$- F_{AB(x)} - F_{BC(x)} + F_{BD} = 0$

$-17{,}32 - 17{,}32 + F_{BD} = 0$

$- 34{,}64 + F_{BD} = 0$

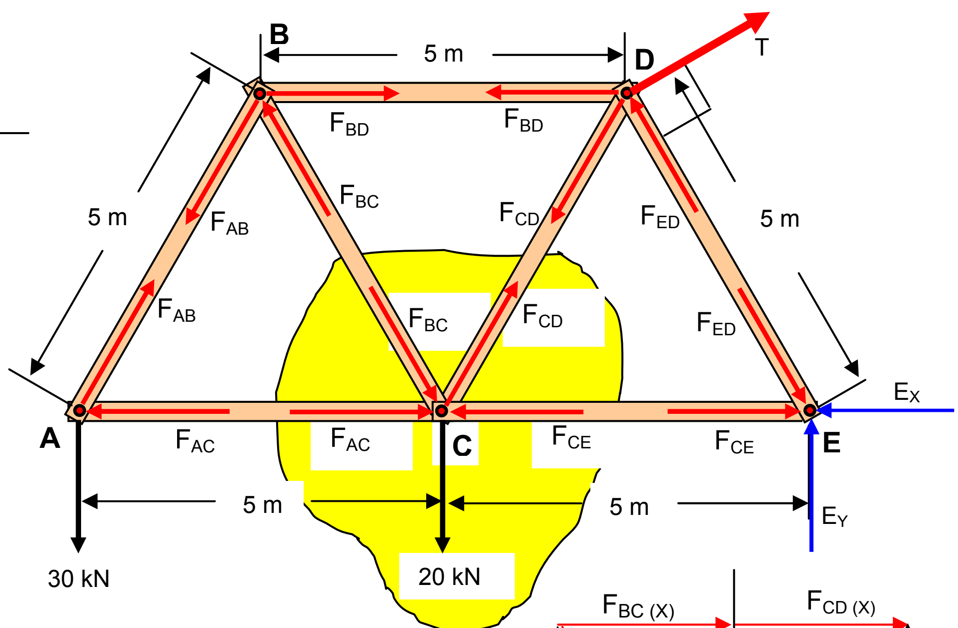
F_{BD} = 34,64 KN (tensión)

$$F_{BC}(x) = \left(\frac{\sqrt{3}}{2}\right) F_{BC}$$

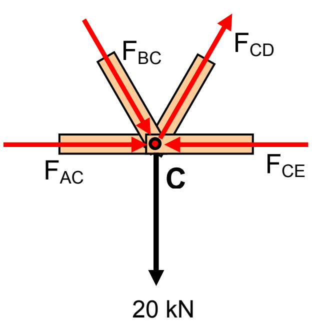
PERO: **F_{BC} = 34,64 kN**

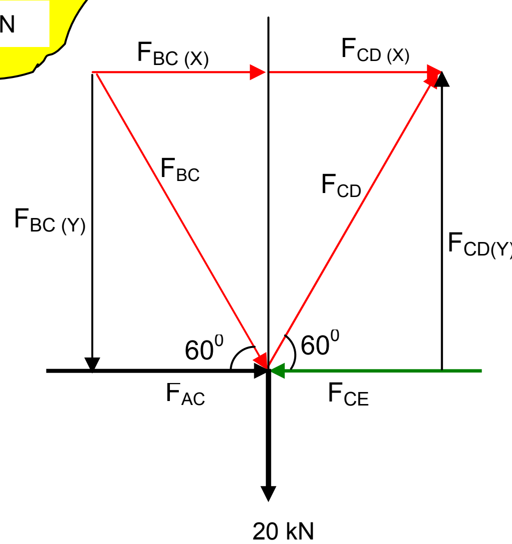
$$F_{BC}(x) = \left(\frac{1}{2}\right)(34{,}64) = 17{,}32 \text{ KN}$$

$F_{BC(x)}$ = 17,32 KN



NUDO C





PERO:
F_{AC} = 17,32 kN (compresion)
F_{BC} = 34,64 kN (compresión)
$F_{BC(x)}$ = 17,32 KN

$$F_{BC}(Y) = \left(\frac{\sqrt{3}}{2}\right) F_{BC}$$

$$F_{BC}(Y) = \left(\frac{\sqrt{3}}{2}\right)(34{,}64) = 30 \text{ KN}$$

$F_{BC(Y)}$ = 30 KN

$$\cos 60 = \frac{F_{CD(X)}}{F_{CD}}$$

$F_{CD(X)} = F_{CD} \cos 60$

$$F_{CD(x)} = \left(\frac{1}{2}\right) F_{CD}$$

$$\text{sen } 60 = \frac{F_{CD(Y)}}{F_{CD}}$$

$F_{CD(Y)} = F_{CD}$ sen 60

$$F_{CD(Y)} = F_{CD}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{CD(Y)} = \left(\frac{\sqrt{3}}{2}\right) F_{CD}$$

$\sum F_X = 0$

$F_{CD(x)} + F_{BC(x)} + F_{AC} – F_{CE} = 0$

PERO:
F_{AC} = 17,32 kN (compresión)
$F_{BC(x)}$ = 17,32 KN

$F_{CD(x)} + \cancel{17{,}32} + \cancel{17{,}32} – F_{CE} = 0$

$\mathbf{F_{CD(x)} + 34{,}64 – F_{CE} = 0}$

$$\left(\frac{1}{2}\right) F_{CD} - F_{CE} = -34{,}64 \quad \textbf{(Ecuación 1)}$$

$$F_{CD(Y)} = \left(\frac{\sqrt{3}}{2}\right) F_{CD}$$

$$F_{CD} = \left(\frac{2}{\sqrt{3}}\right) F_{CD(Y)}$$

PERO: **$F_{CD(Y)}$ = 50 KN**

$$F_{CD} = \left(\frac{2}{\sqrt{3}}\right) 50 = 57{,}73 \text{ KN}$$

F_{CD} = 57,73 kN (Tensión)

Reemplazar en la ecuación 1

$$\left(\frac{1}{2}\right) F_{CD} - F_{CE} = -34{,}64 \quad \textbf{(Ecuación 1)}$$

$$\left(\frac{1}{2}\right) 57{,}73 - F_{CE} = -34{,}64$$

28,86 – F_{CE} = - 34,64

– F_{CE} = - 34,64 - 28,86

– F_{CE} = - 63,5 (-1)

F_{CE} = 63,5 KN (compresión)

$\sum F_Y = 0$

- $F_{BC(Y)} + F_{CD(Y)} – 20 = 0$

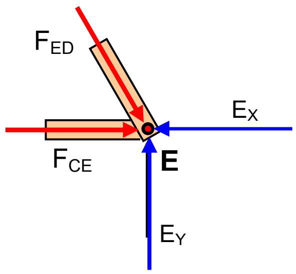
PERO:
$F_{BC(Y)}$ = 30 KN

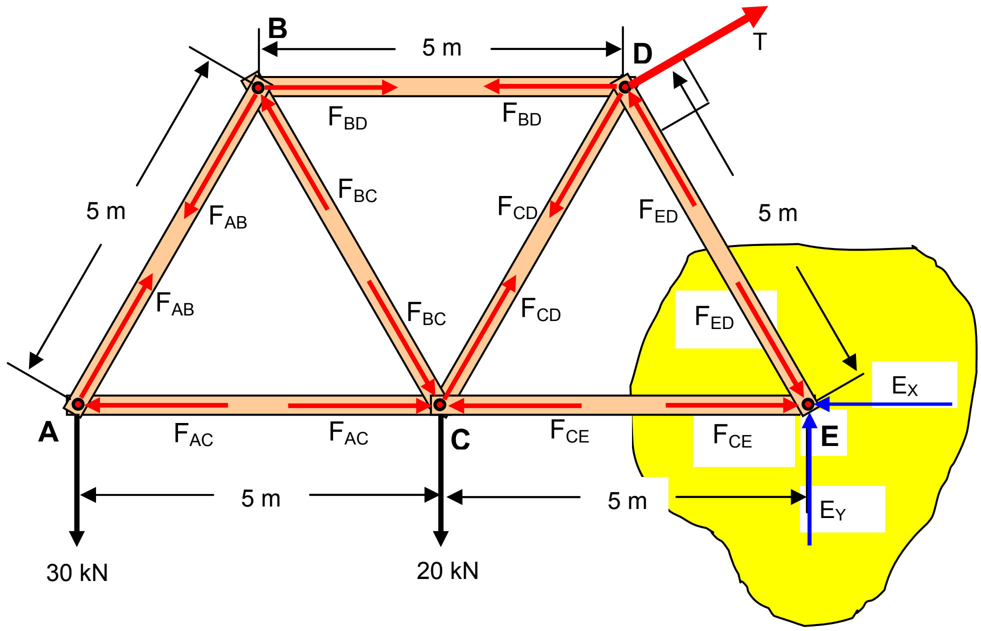
- 30 + $F_{CD(Y)}$ – 20 = 0

- 50 + $F_{CD(Y)}$ = 0

$F_{CD(Y)}$ = 50 KN

NUDO E





$\sum F_Y = 0$

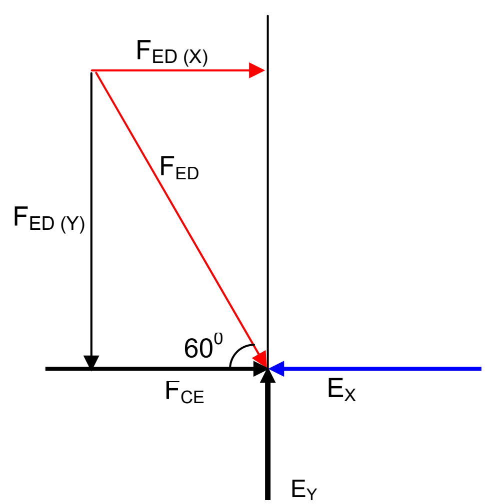
$E_Y - F_{ED\,(Y)} = 0$

$F_{ED\,(Y)} = E_Y$

PERO:
$E_Y = 10$ KN

$F_{ED\,(Y)}$ = 10 KN

$$\text{sen } 60 = \frac{F_{ED(Y)}}{F_{ED}}$$



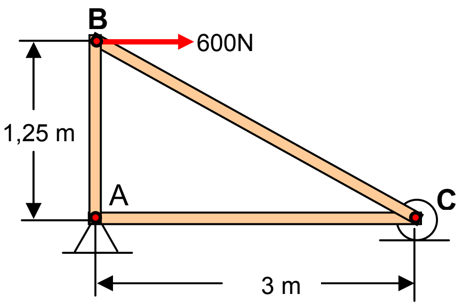
$F_{ED\,(Y)} = F_{ED}$ sen 60

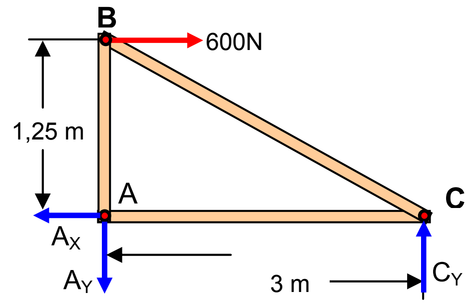
$$F_{ED} = \frac{F_{ED(Y)}}{\text{sen } 60} = \frac{10}{0{,}866} = 11{,}54 \text{ kN}$$

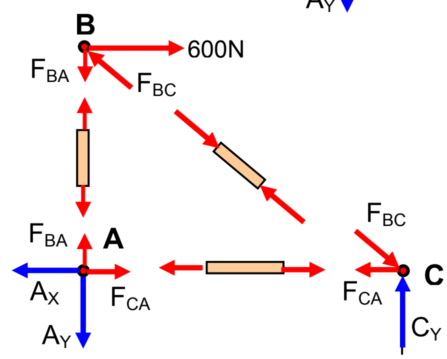
F_{ED} = 11,54 KN (compresión)

T = 80 N E_X = 69,28 N	**E_Y = 10 KN**
F_{AB} = 34,64 kN (tensión)	**F_{AC} = 17,32 kN (compresión)**
F_{BC} = 34,64 kN (compresión)	**F_{BD} = 34,64 KN (tensión)**
F_{CD} = 57,73 kN (Tensión)	**F_{CE} = 63,5 KN (compresión)**
F_{ED} = 11,54 KN (compresión)	

Problema 4.1 Estática Meriam edición tres
Hallar la fuerza en cada miembro de la armadura cargada







$\Sigma M_A = 0$

$+$ $\quad C_Y (3) - 600 (1,25) = 0$

$3 C_Y - 750 = 0$

$3 C_Y = 750$

$$C_Y = \frac{750}{3} = 250 \text{ N}$$

C_Y = 250 N

$\Sigma M_C = 0$

$+$ $\quad A_Y (3) - 600 (1,25) = 0$

$3 A_Y - 750 = 0$

$3 A_Y = 750$

$$A_Y = \frac{750}{3} = 250 \text{ N}$$

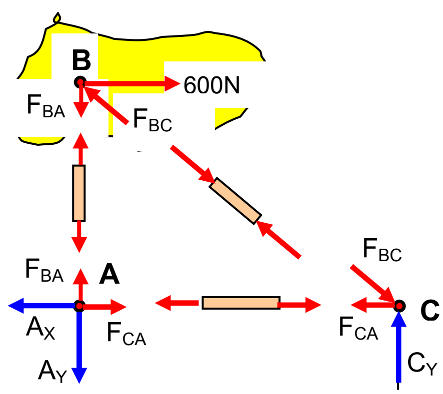
A_Y = 250 N

$\Sigma F_X = 0$

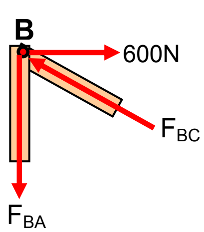
$600 - A_X = 0$

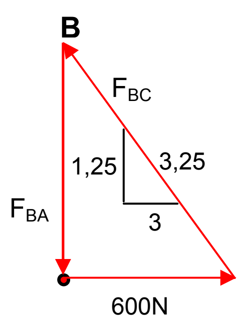
$600 = A_X$

A_X = 600 Newton



Nudo B





$$\frac{F_{BC}}{3,25} = \frac{F_{BA}}{1,25} = \frac{600}{3}$$

$$\frac{F_{BC}}{3,25} = \frac{F_{BA}}{1,25} = 200$$

Hallar F_{BC}

$$\frac{F_{BC}}{3,25} = 200$$

$F_{BC} = 200 \ (3,25)$

F_{BC} = 650 Newton (compresión)

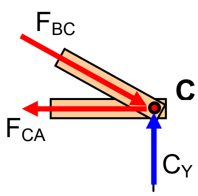
Hallar F_{AB}

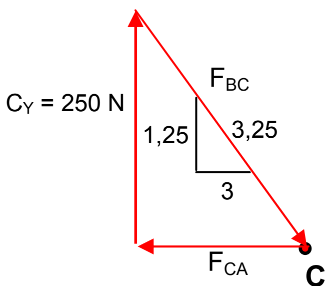
$$\frac{F_{BA}}{1,25} = 200$$

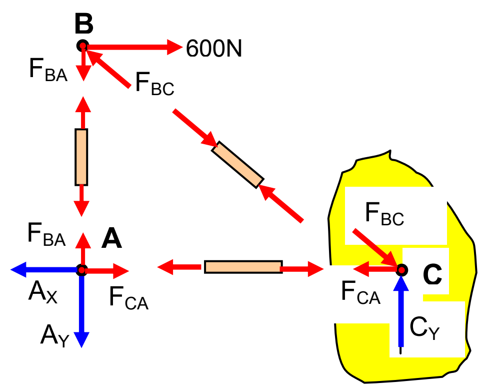
$F_{AB} = 200\ (1,25)$

F_{AB} = 250 Newton (tracción)

Nudo C







$$\frac{F_{BC}}{3,25} = \frac{C_Y}{1,25} = \frac{F_{CA}}{3}$$

F_{BC} = 650 Newton (compresión)

$$\frac{650}{3,25} = \frac{C_Y}{1,25} = \frac{F_{CA}}{3}$$

Hallar F_{CA}

$$\frac{650}{3,25} = \frac{F_{CA}}{3}$$

$$F_{CA} = \frac{(650)\,3}{3,25}$$

F_{CA} = 600 Newton (tracción)

C_Y = 250 N A_X = 600 Newton

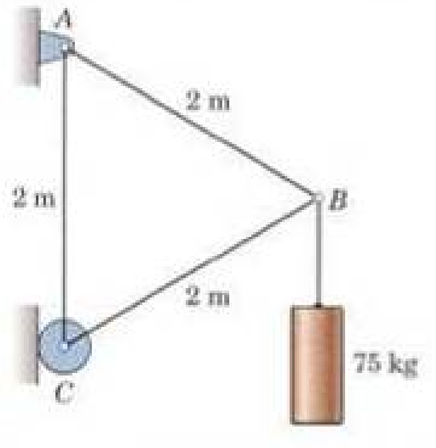
A_Y = 250 N

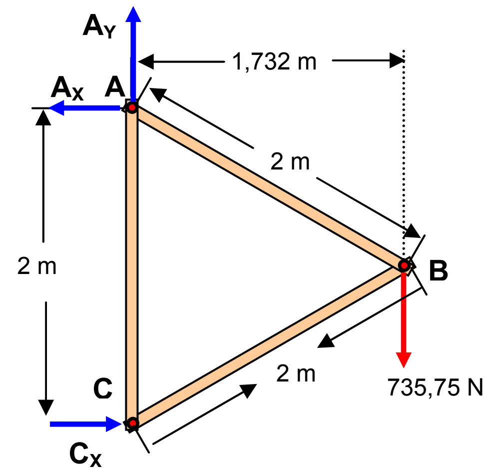
F_{AB} = 250 Newton (tracción)

F_{BC} = 650 Newton (compresión)

F_{CA} = 600 Newton (tracción)

Problema 4.1 Estática Meriam edición cinco; Problema 4.2 Estática Meriam edición tres
Hallar la fuerza en cada miembro de la armadura simple equilátera





$\Sigma M_A = 0$

$+$ $C_X (2) - 735,75 (1,732) = 0$

$C_X (2) = 1274,31$

$$C_X = \frac{1274,31}{2} = 637,15 \text{ N}$$

C_X = 637,15 Newton

W = m x g

$$w = 75 \text{ kg} \left(9,81 \frac{\text{m}}{\text{seg}^2} \right) = 735,75 \text{ Newton}$$

W = 735,75 Newton

$\sum F_X = 0$

$C_X - A_X = 0$

$C_X = A_X$

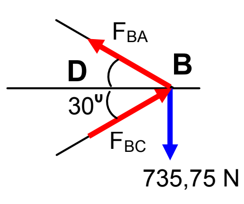
A_X = 637,15 Newton

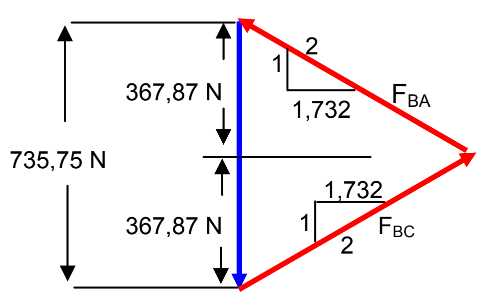
$\sum F_Y = 0$

$A_Y - 735,75 = 0$

A_Y = 735,75 Newton

Nudo B





$$\frac{F_{BA}}{2} = \frac{367,87}{1}$$

$F_{BA} = 2 \text{ X } 367,87$

F_{BA} = 735,75 Newton

$$\frac{F_{BC}}{2} = \frac{367,87}{1}$$

$F_{BC} = 2 \text{ X } 367,87$

F_{BC} = 735,75 Newton

Nudo C

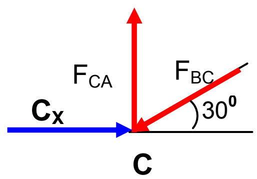
$$\frac{F_{BC}}{2} = \frac{F_{CA}}{1} = \frac{C_X}{1{,}732}$$

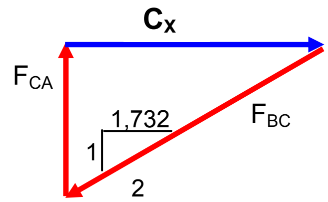
F_{BC} = 735,75 Newton (compresión)

$$\frac{735{,}75}{2} = \frac{F_{CA}}{1}$$

$$F_{CA} = \frac{735{,}75}{2}$$

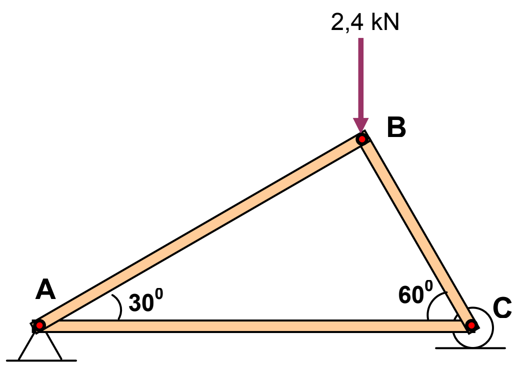
F_{CA} = 367,87 **Newton (tensión)**

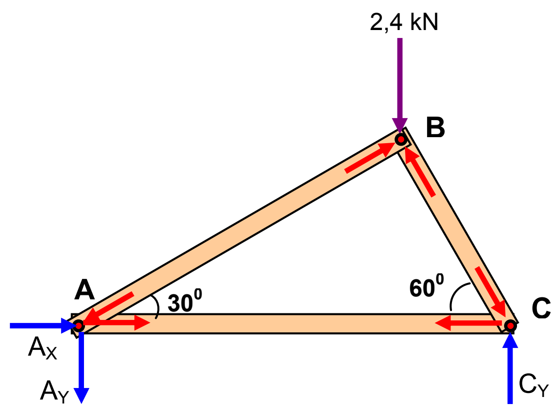




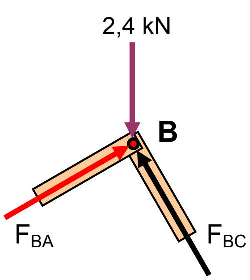
Problema 4.3 Estática Meriam edición tres

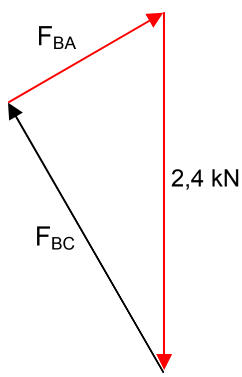
Hallar la fuerza en cada miembro de la armadura cargada. Explicar por que no hace falta saber las longitudes de los miembros.

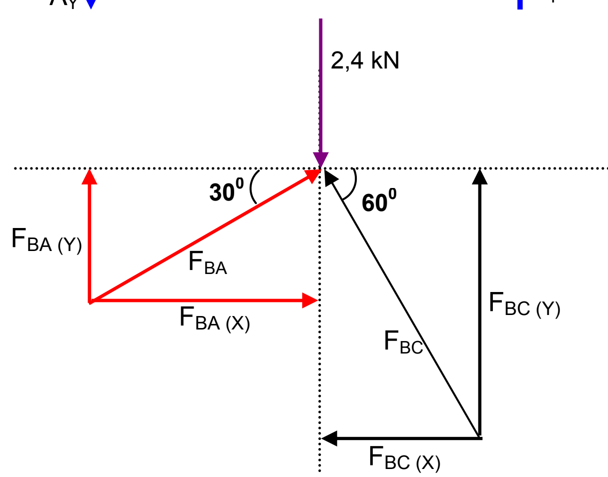




Nudo B







$$\text{sen } 30 = \frac{F_{BA(Y)}}{F_{BA}}$$

$F_{BA(Y)}$ = F_{BA} sen 30

$$F_{BA(Y)} = F_{BA}\left(\frac{1}{2}\right)$$

$$F_{BA(Y)} = \left(\frac{1}{2}\right) F_{BA}$$

Para abreviar los cálculos

$$\text{sen } 30 = \frac{1}{2} \qquad \text{sen } 60 = \frac{\sqrt{3}}{2} \qquad \cos 60 = \frac{1}{2} \qquad \cos 30 = \frac{\sqrt{3}}{2}$$

$$\text{sen } 60 = \frac{F_{BC(Y)}}{F_{BC}}$$

$F_{BC(Y)} = F_{BC}$ sen 60

$$F_{BC(Y)} = F_{BC}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{BC(Y)} = \left(\frac{\sqrt{3}}{2}\right)F_{BC}$$

$$\cos 60 = \frac{F_{BC(X)}}{F_{BC}}$$

$F_{BC(X)} = F_{BC}$ cos 60

$$F_{Bc(x)} = F_{BC}\left(\frac{1}{2}\right)$$

$$F_{Bc(x)} = \left(\frac{1}{2}\right)F_{BC}$$

$$\cos 30 = \frac{F_{BA(X)}}{F_{BA}}$$

$F_{BA(X)} = F_{BA}$ cos 30

$$F_{BA(x)} = F_{BA}\left(\frac{\sqrt{3}}{2}\right)$$

$$F_{BA(x)} = \left(\frac{\sqrt{3}}{2}\right)F_{BA}$$

$\sum F_X = 0$

$F_{BA(X)} - F_{BC(X)} = 0$

$$\left(\frac{\sqrt{3}}{2}\right)F_{BA} - \left(\frac{1}{2}\right)F_{BC} = 0 \quad \textbf{(ECUACIÓN 1)}$$

$\sum F_Y = 0$

$F_{BA(Y)} + F_{BC(Y)} - 2{,}4 = 0$

$$\left(\frac{1}{2}\right)F_{BA} + \left(\frac{\sqrt{3}}{2}\right)F_{BC} = 2{,}4 \quad \textbf{(ECUACIÓN 2)}$$

Resolver las ecuaciones

$$\left(\frac{\sqrt{3}}{2}\right)F_{BA} - \left(\frac{1}{2}\right)F_{BC} = 0 \quad \left(\sqrt{3}\right)$$

$$\left(\frac{1}{2}\right)F_{BA} + \left(\frac{\sqrt{3}}{2}\right)F_{BC} = 2{,}4$$

$$\left(\frac{3}{2}\right)F_{BA} - \cancel{\left(\frac{\sqrt{3}}{2}\right)F_{BC}} = 0$$

$$\left(\frac{1}{2}\right)F_{BA} + \cancel{\left(\frac{\sqrt{3}}{2}\right)F_{BC}} = 2{,}4$$

$$\left(\frac{3}{2}\right)F_{BA} + \left(\frac{1}{2}\right)F_{BA} = 2{,}4$$

$2\ F_{BA} = 2{,}4$

$$F_{BA} = \frac{2{,}4}{2} = 1{,}2 \text{ kN}$$

F_{BA} = 1,2 kN (compresión)

$$\left(\frac{\sqrt{3}}{2}\right) F_{BA} - \left(\frac{1}{2}\right) F_{BC} = 0 \text{ **(ECUACIÓN 1)**}$$

$$\left(\frac{\sqrt{3}}{\cancel{2}}\right) F_{BA} = \left(\frac{1}{\cancel{2}}\right) F_{BC}$$

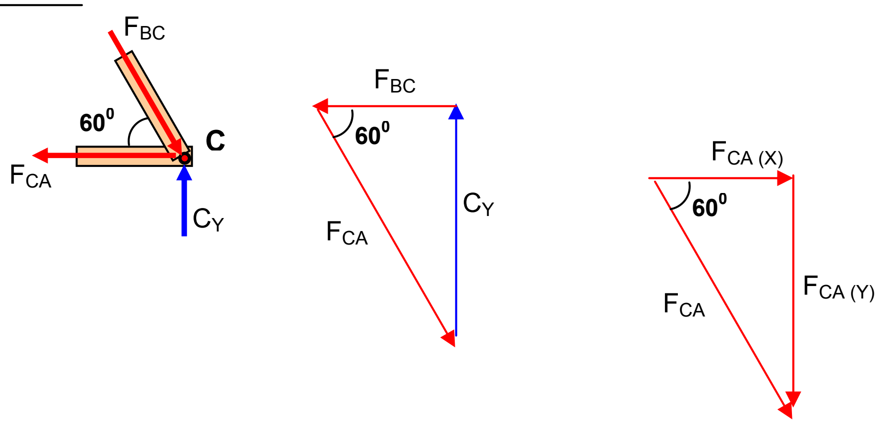
$$\sqrt{3}\, F_{BA} = F_{BC}$$

F_{BA} = 1,2 kN

$$\sqrt{3}\,(1{,}2) = F_{BC}$$

F_{BC} = 2,078 kN (compresión)

Nudo C



$$\cos 60 = \frac{F_{CA(X)}}{F_{CA}}$$

$F_{CA\,(X)}$ = (cos 60) F_{CA}

$\sum F_X = 0$

$F_{CA\,(X)} - F_{BC} = 0$

(cos 60) F_{CA} - F_{BC} = 0

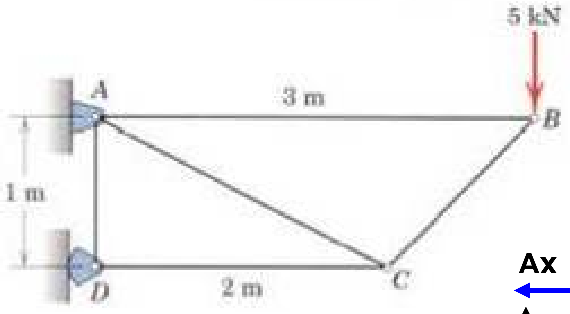
(cos 60) F_{CA} = F_{BC}

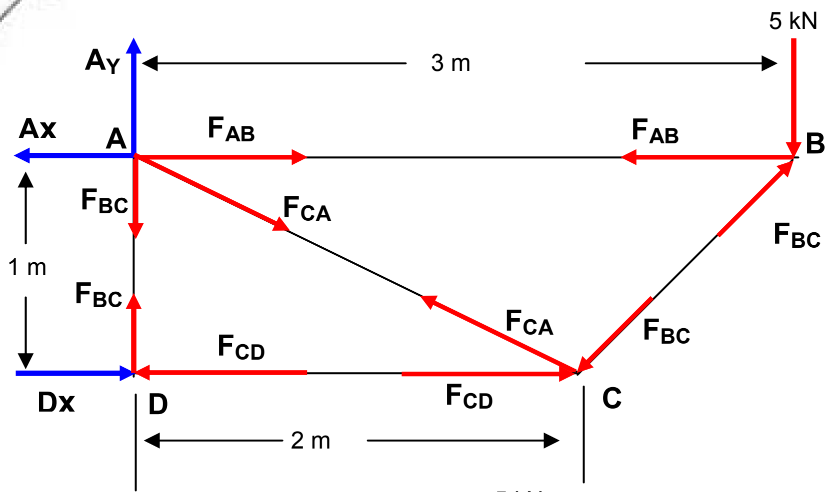
$$F_{CA} = \frac{F_{BC}}{\cos 60} = \frac{2{,}078}{0{,}5} = 1{,}039 \text{ kN}$$

F_{BA} = 1,039 kN (tracción)

Problema 4.3 Estática Meriam edición cinco

Determine the force in each member of the truss. Note the presence of any zero-force members.





$\Sigma M_A = 0$

$+ \quad D_X (1) - 5 (3) = 0$

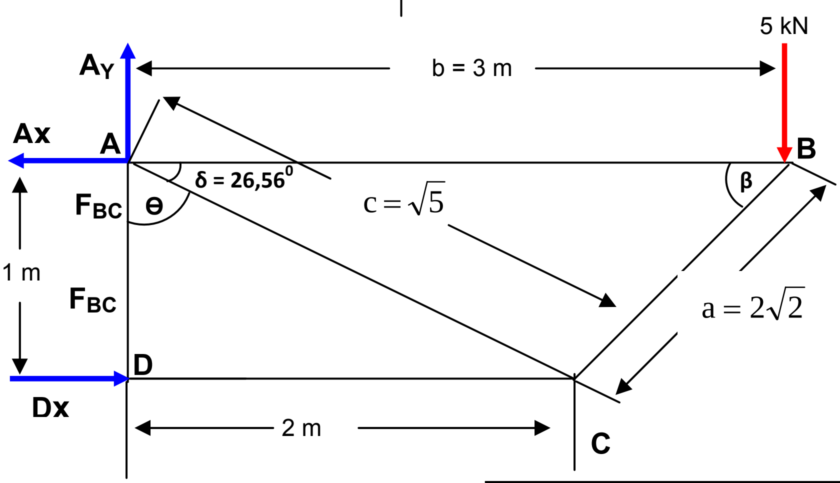
$D_X - 15 = 0$

D_X = 15 KN

$\Sigma F_X = 0$

$D_X - A_X = 0$

$D_X = A_X$



ley de cosenos

$a^2 = b^2 + c^2 - 2\, b\, c \text{ sen } \delta$

$$a^2 = (3)^2 + \left(\sqrt{5}\right)^2 - 2\,(3)\left(\sqrt{5}\right)\text{sen } 26{,}56$$

$$a^2 = 9 + 5 - 6\left(\sqrt{5}\right)(0{,}4471)$$

$$a^2 = 14 - 2{,}68\left(\sqrt{5}\right)$$

$$a^2 = 14 - 6 \qquad a^2 = 8$$

$$a = \sqrt{8} = 2\sqrt{2}$$

PERO: D_X = 15 KN

A_X = 15 KN

$\Sigma F_Y = 0$

$A_Y - 5 = 0$

A_Y = 5 KN

$$\text{tg } \theta = \frac{2}{1}$$

Θ = arc tg (2)

$\Theta = 63{,}43^0$

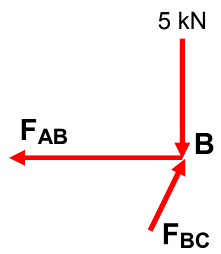
$\Theta + \delta = 90^0$

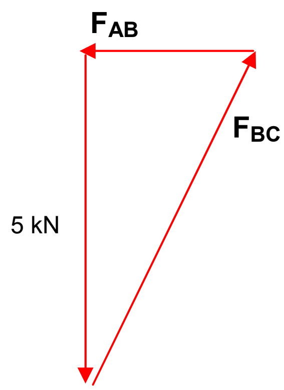
$\delta = 90^0 - \Theta$

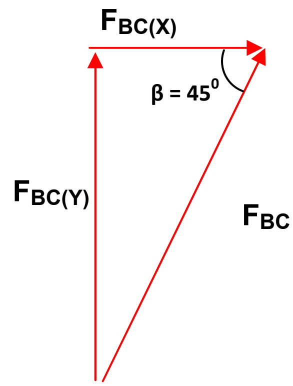
$\delta = 90^0 - 63{,}43$

$\boldsymbol{\delta = 26{,}56^0}$

NUDO B







ley de cosenos

$c^2 = a^2 + b^2 - 2\, a\, b \text{ sen } \beta$

$$\left(\sqrt{5}\right)^2 = \left(2\sqrt{2}\right)^2 + (3)^2 - 2\left(2\sqrt{2}\right)(3) \text{ sen } \beta$$

$$5 = 8 + 9 - 12\left(\sqrt{2}\right) \text{sen } \beta$$

$$5 = 8 + 9 - 16{,}97 \text{ sen } \beta$$

$$5 = 17 - 16{,}97 \text{ sen } \beta$$

$$16{,}97 \text{ sen } \beta = 17 - 5 = 12$$

$$\text{sen } \beta = \frac{12}{16{,}97} = 0{,}7071$$

$\beta = \text{arc tg } 0{,}7071$

$\beta = 45^0$

$\cos \beta = \cos 45 = 0{,}7071$

$\text{sen } \beta = \text{sen } 45 = 0{,}7071$

$F_{BC(X)} = F_{BC} \cos 45$

Pero:
$F_{BC} = 7{,}071$ KN

$F_{BC(X)} = F_{BC} \cos 45$

$$\cos 45 = \frac{F_{BC(X)}}{F_{BC}}$$

$F_{BC(X)} = F_{BC} \cos 45$

$\Sigma F_Y = 0$

$F_{BC(Y)} - 5 = 0$

$F_{BC(Y)} = 5$ kN

$$F_{BC} = \frac{F_{BC(Y)}}{\text{sen } 45} = \frac{5}{0{,}7071} = 7{,}071 \text{ kN}$$

$F_{BC} = 7{,}071$ KN

$F_{BC(X)} = F_{BC} \cos 45$

Pero:

$F_{BC} = 7{,}071$ KN

$F_{BC(X)} = F_{BC} \cos 45$

$F_{BC(X)} = (7{,}071)\ (0{,}7071)$

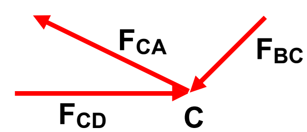
$F_{BC(X)} = 5$ kN

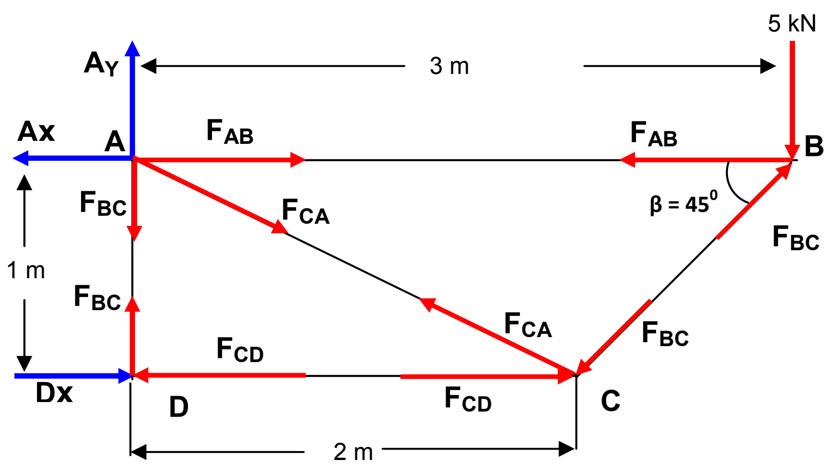
$\Sigma F_X = 0$

$F_{BC(X)} - F_{AB} = 0$

$F_{AB} = F_{BC(X)}$ **$F_{AB} = 5$ kN**

NUDO C





$$\cos 26{,}56 = \frac{F_{CA(X)}}{F_{CA}}$$

$F_{CA(X)} = F_{CA} \cos 26{,}56$

$F_{CA(X)} = 0{,}8944\ F_{CA}$

$\Sigma F_Y = 0$

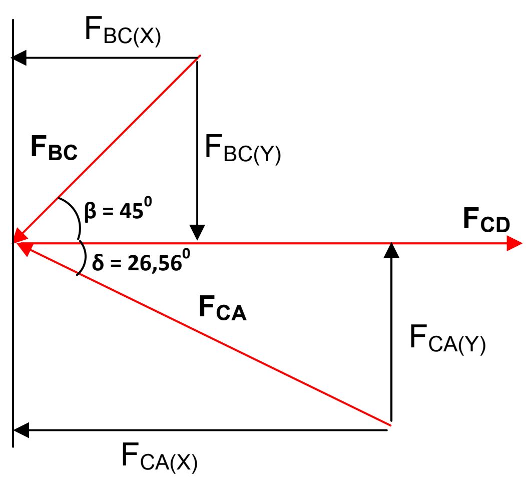
$F_{CA(Y)} - F_{BC(Y)} = 0$

$F_{CA(Y)} = F_{BC(Y)}$

Pero: $F_{BC\ (Y)} = 5$ kN

$F_{CA(Y)} = 5$ kN

$$\text{sen } 26{,}56 = \frac{F_{CA(Y)}}{F_{CA}}$$



$$F_{CA} = \frac{F_{CA(Y)}}{\text{sen } 26,56} = \frac{5}{0,4471} = 11,18 \text{ kN}$$

F_{CA} = 11,18 kN (tensión)

Reemplazando la ecuación 1

F_{CD} – 0,8944 F_{CA} = 5 (Ecuación 1)

Pero: F_{CA} = 11,18 kN

F_{CD} – 0,8944 (11,18) = 5

F_{CD} – 10 = 5

F_{CD} = 5 + 10 = 15 kN

F_{CD} = 15 Kn (compresión)

$\Sigma F_X = 0$

$- F_{BC(X)} + F_{CD} – F_{CA(X)} = 0$

Pero: $F_{BC(X)}$ = 5 kN

$- 5 + F_{CD} – F_{CA(X)} = 0$

$F_{CD} – F_{CA(X)} = 5$

$F_{CA(X)}$ = 0,8944 F_{CA}

F_{CD} – 0,8944 F_{CA} = 5 (Ecuación 1)

NUDO D

$\Sigma F_X = 0$

$D_X - F_{CD} = 0$

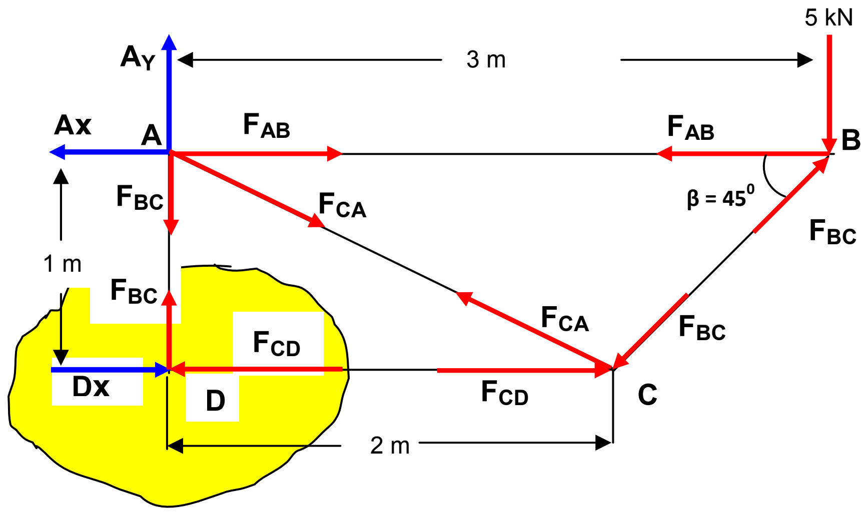
$D_X = F_{CD}$

Pero:

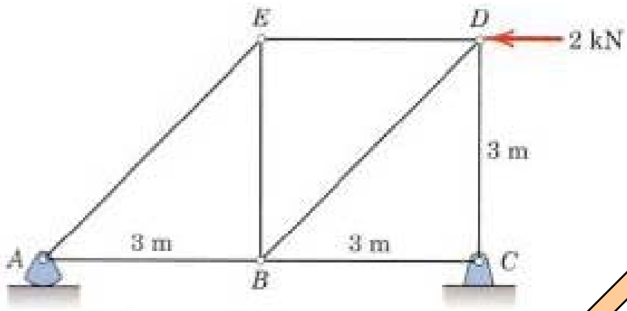
F_{CD} = 15 Kn

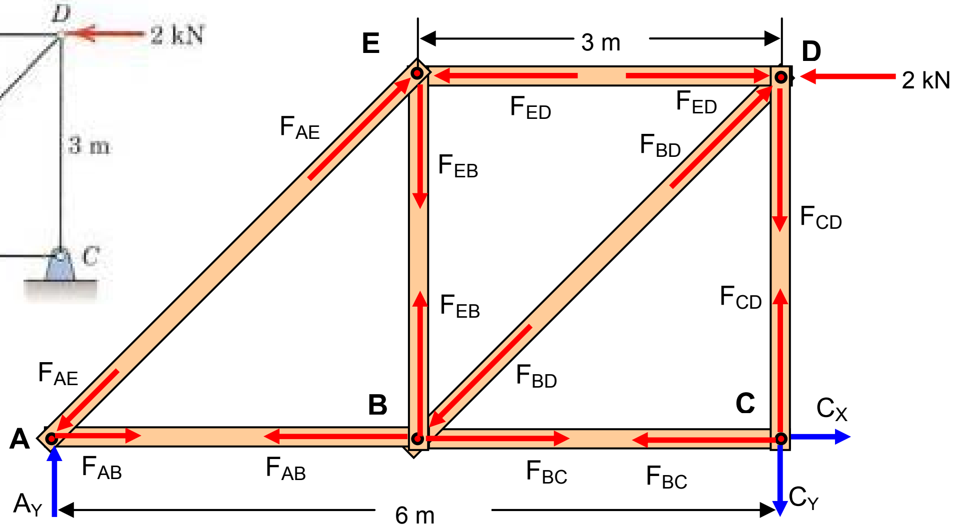
$\Sigma F_y = 0$

F_{BC} = 0



Problema 4.4 Estática Meriam edición tres; Problema 4.6 Estática Meriam edición cinco;
Hallar la fuerza en cada miembro de la armadura cargada





$\Sigma M_C = 0$

\+ $- A_Y (6) + 2 (3) = 0$

$6 A_Y = 2 (3)$

$A_Y = 1$ kN

$\Sigma F_X = 0$

$C_X - 2 = 0$

$C_X = 2$ kN

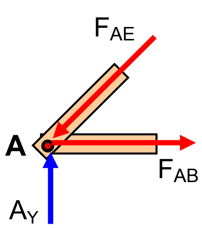
$\Sigma M_A = 0$

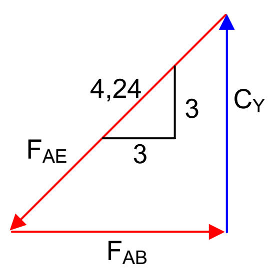
\+ $2 (3) - C_Y (6) = 0$

$2 (3) = C_Y (6)$

$C_Y = 1$ kN

Nudo A





$$\frac{C_Y}{3} = \frac{F_{AB}}{3} = \frac{F_{AE}}{4,24}$$

$C_Y = 1$ kN

$$\frac{1}{3} = \frac{F_{AB}}{3} = \frac{F_{AE}}{4,24}$$

Se halla F_{AB}

$$\frac{1}{3} = \frac{F_{AB}}{3}$$

$F_{AB} = 1$ kN (tension)

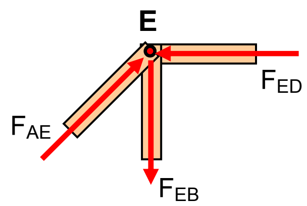
Se halla F_{AE}

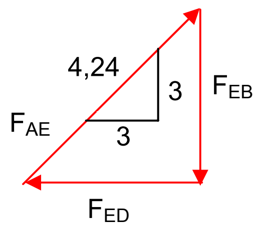
$$\frac{1}{3} = \frac{F_{AE}}{4,24}$$

$$F_{AE} = \frac{4,24}{3} = 1,41 kN$$

$F_{AE} = 1,413$ Kn (compresión)

Nudo E





$$\frac{F_{EB}}{3} = \frac{F_{ED}}{3} = \frac{F_{AE}}{4{,}24}$$

F_{AE} = 1,413 kN

$$\frac{F_{EB}}{3} = \frac{F_{ED}}{3} = \frac{1{,}413}{4{,}24}$$

$$\frac{F_{EB}}{3} = \frac{F_{ED}}{3} = 0{,}3332$$

Se halla **F_{EB}**

$$\frac{F_{EB}}{3} = 0{,}3332$$

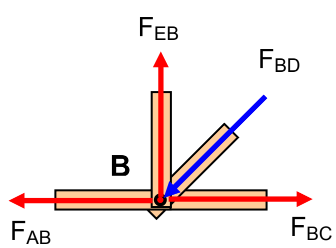
F_{EB} = 3 (0,3332) = 1 kN (tensión)

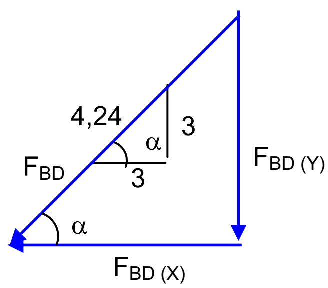
Se halla **F_{ED}**

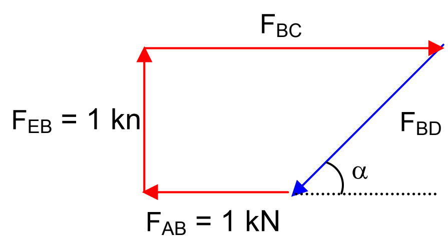
$$\frac{F_{ED}}{3} = 0{,}3332$$

F_{ED} = 3 (0,3332) = 1 kN (compresión)

Nudo B







$$\text{tg}\ \alpha = \frac{3}{3} = 1$$

α = arc tg (1)

$\alpha = 45^0$

$$\text{sen}\ \alpha = \frac{F_{BD(Y)}}{F_{BD}}$$

$$\text{sen}\ 45 = \frac{F_{BD(Y)}}{F_{BD}}$$

F_{BD} (sen 45) = $F_{BD(Y)}$

$$\cos \alpha = \frac{F_{BD(X)}}{F_{BD}}$$

$$\cos 45 = \frac{F_{BD(X)}}{F_{BD}}$$

$\sum F_Y = 0$

$F_{EB} - F_{BD(Y)} = 0$

$F_{EB} = F_{BD(Y)}$

F_{EB} = 3 (0,3332) = 1 kN

$1 = F_{BD(Y)}$

$1 = F_{BD}$ (sen 45)

$$F_{BD} = \frac{1}{\text{sen}\ 45} = \frac{1}{0{,}7071} = 1{,}414\ \text{kN}$$

F_{BD} = 1,414 kN

$F_{BD\,(X)} = F_{BD}$ (cos 45)

F_{BD} = 1,414 kN

$F_{BD\,(X)}$ = 1,414 (cos 45)

$F_{BD\,(X)}$ = 1,414 (0,7071)

$F_{BD\,(X)}$ = 1 kN

$\sum F_X = 0$

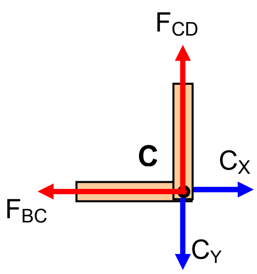
$F_{BC} - F_{BD\,(X)} - F_{AB} = 0$ Pero: **F_{AB} = 1 kN**

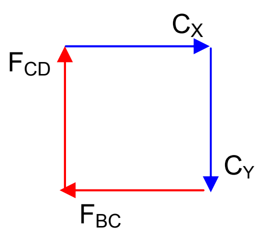
$F_{BC} = F_{BD\,(X)} + F_{AB}$ Pero: **$F_{BD\,(X)}$ = 1 kN**

$F_{BC} = 1 + 1$

F_{BC} = 2 kN

Nudo C





$\sum F_X = 0$

$C_X - F_{BC} = 0$

$C_X = F_{BC}$

F_{BC} = 2 kN (tracción)

$C_X = F_{BC}$ = 2 kN

$\sum F_Y = 0$

$F_{CD} - C_Y = 0$

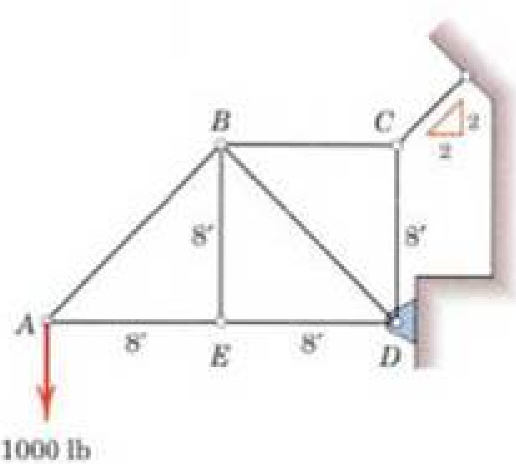
$F_{CD} = C_Y$

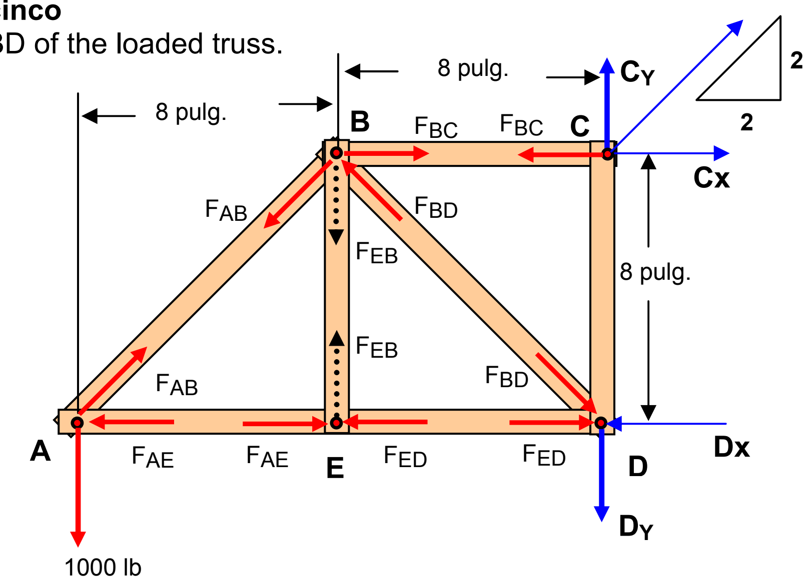
C_Y = 1 kN

$F_{CD} = C_Y$ = 1 kN (tracción)

Problema 4.4 Estática Meriam edición cinco

Calculate the forces in members BE and BD of the loaded truss.





$\Sigma M_C = 0$

$+$ $1000\,(8 + 8) - D_X\,(8) = 0$

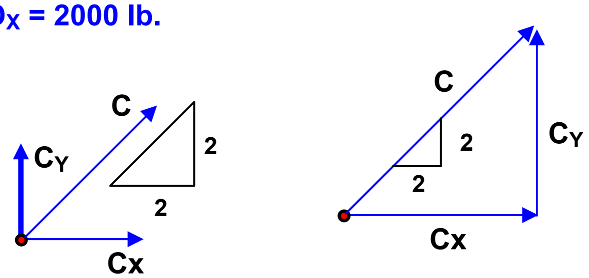
$1000\,(16) - 8\,D_X = 0$

$16000 - 8\,D_X = 0$

$8\,D_X = 16000$

$$D_X = \frac{16000}{8} = 2000\,\text{lb.}$$

D_X = 2000 lb.



$\sum F_X = 0$

$C_X - D_X = 0$

$C_X = D_X$

PERO: $D_X = 2000$ lb.

$C_X = 2000$ lb.

Las ecuaciones de equilibrio para la fuerza C son:

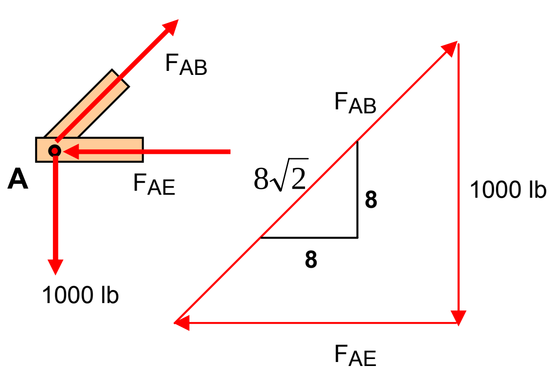
$$\frac{C_Y}{\cancel{2}} = \frac{C_X}{\cancel{2}}$$

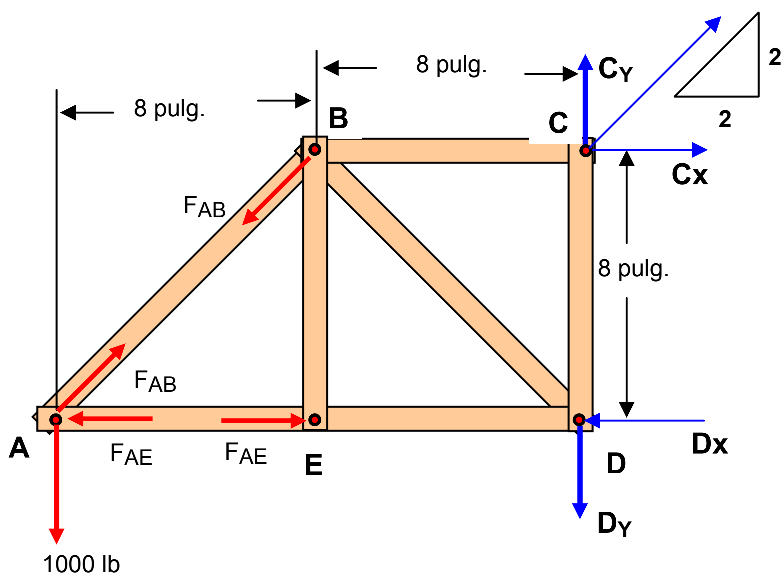
Cancelando términos semejantes

$C_Y = C_X$

PERO: $C_X = 2000$ lb.
$C_Y = 2000$ lb.

NUDO A





Las ecuaciones de equilibrio son:

$$\frac{F_{AB}}{\cancel{8}\sqrt{2}} = \frac{1000}{\cancel{8}} = \frac{F_{AE}}{\cancel{8}}$$

Cancelando términos semejantes

$$\frac{F_{AB}}{\sqrt{2}} = 1000 = F_{AE}$$

Hallar F_{AE}

$$1000 = F_{AE}$$

F_{AE} = 1000 lb. (Compresión)

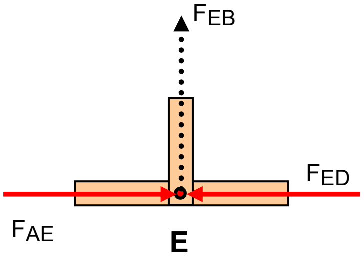
Hallar F_{AB}

$$\frac{F_{AB}}{\sqrt{2}} = 1000$$

$$F_{AB} = 1000\left(\sqrt{2}\right)$$

F_{AB} = 1414,21libras (tensión)

NUDO E



$\Sigma F_Y = 0$

$F_{EB} = 0$

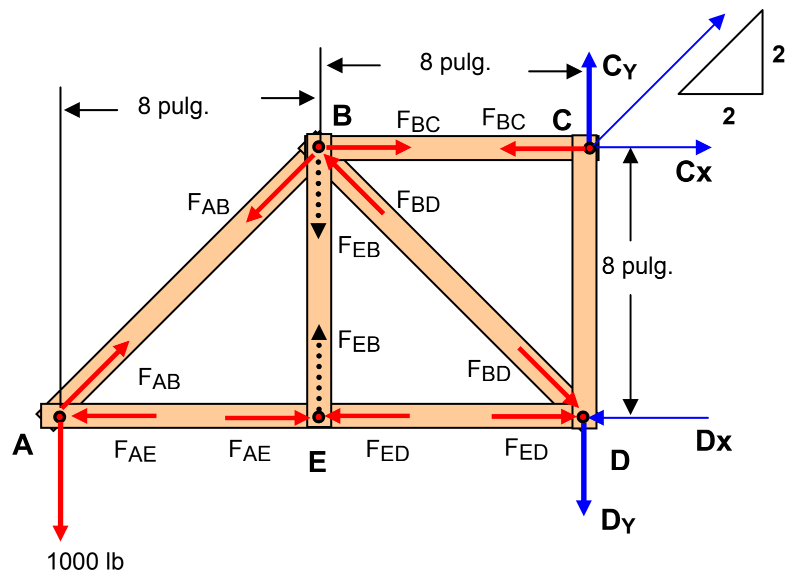
$\sum F_X = 0$

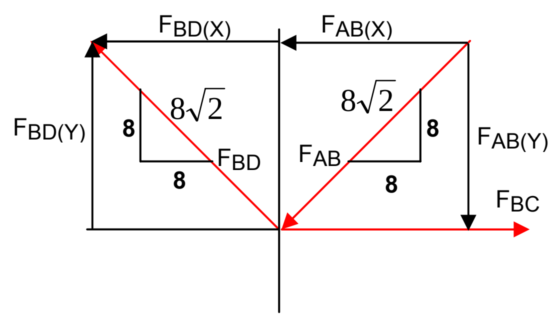
$F_{AE} - F_{ED} = 0$

$F_{AE} = F_{ED}$

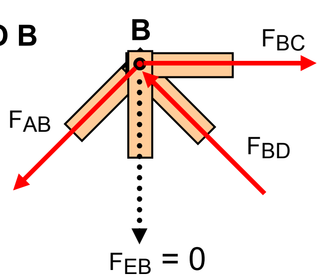
PERO: F_{AE} = 1000 lb.

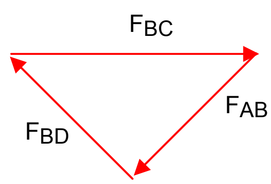
F_{ED} = 1000 lb. (Compresión)





NUDO B





Hallar $F_{AB(X)}$

$$\frac{F_{AB}}{\sqrt{2}} = F_{AB(X)}$$

$$\frac{1414{,}2}{\sqrt{2}} = F_{AB(X)}$$

$F_{AB(X)}$ = 1000 lb.

Las ecuaciones de equilibrio para la junta B son:

$$\frac{F_{AB}}{\cancel{8}\sqrt{2}} = \frac{F_{AB(Y)}}{\cancel{8}} = \frac{F_{AB(X)}}{\cancel{8}}$$

Cancelando términos semejantes

$$\frac{F_{AB}}{\sqrt{2}} = F_{AB(Y)} = F_{AB(X)}$$

PERO: **F_{AB} = 1414,21libras**

Hallar $F_{AB(Y)}$

$$\frac{F_{AB}}{\sqrt{2}} = F_{AB(Y)}$$

$$\frac{1414{,}2}{\sqrt{2}} = F_{AB(Y)}$$

$F_{AB(Y)}$ = 1000 lb.

$\Sigma F_Y = 0$

$F_{BD\,(Y)} - F_{AB\,(Y)} = 0$

$F_{BD\,(Y)} = F_{AB\,(Y)}$

Pero: $F_{AB\,(Y)}$ = 1000 lb.

$F_{BD\,(Y)}$ = 1000 lb.

Las ecuaciones de equilibrio para la junta B son:

$$\frac{F_{BD}}{\cancel{8}\sqrt{2}} = \frac{F_{BD(Y)}}{\cancel{8}} = \frac{F_{BD(X)}}{\cancel{8}}$$

Cancelando términos semejantes

$$\frac{F_{BD}}{\sqrt{2}} = F_{BD(Y)} = F_{BD(X)}$$

Pero: $F_{BD\,(Y)}$ = 1000 lb.

$$F_{BD(Y)} = F_{BD(X)}$$

$F_{BD\,(X)}$ = 1000 lb.

$$\frac{F_{BD}}{\sqrt{2}} = F_{BD(Y)}$$

Pero: $F_{BD\,(Y)}$ = 1000 lb.

$$F_{BD} = \left(\sqrt{2}\right) F_{BD(Y)}$$

$$F_{BD} = \left(\sqrt{2}\right) 1000$$

F_{BD} = 1414,2 libras (compresión)

$\sum F_X = 0$

$F_{BC} - F_{BD(X)} - F_{AB(X)} = 0$

PERO: $F_{AB(X)}$ = 1000 lb.

$F_{BC} - F_{BD(X)} = F_{AB(X)}$

$F_{BC} - F_{BD(X)}$ = 1000 ECUACION 1

Hallar F_{BC}

$F_{BC} - F_{BD(X)}$ = 1000 ECUACION 1

PERO:

$F_{BD\,(X)}$ = 1000 lb.

F_{BC} - 1000 = 1000

F_{BC} = 1000 + 1000

F_{BC} = 2000 lb. (tracción)

D_X = 2000 lb.

F_{AB} = 1414,21libras (tensión)

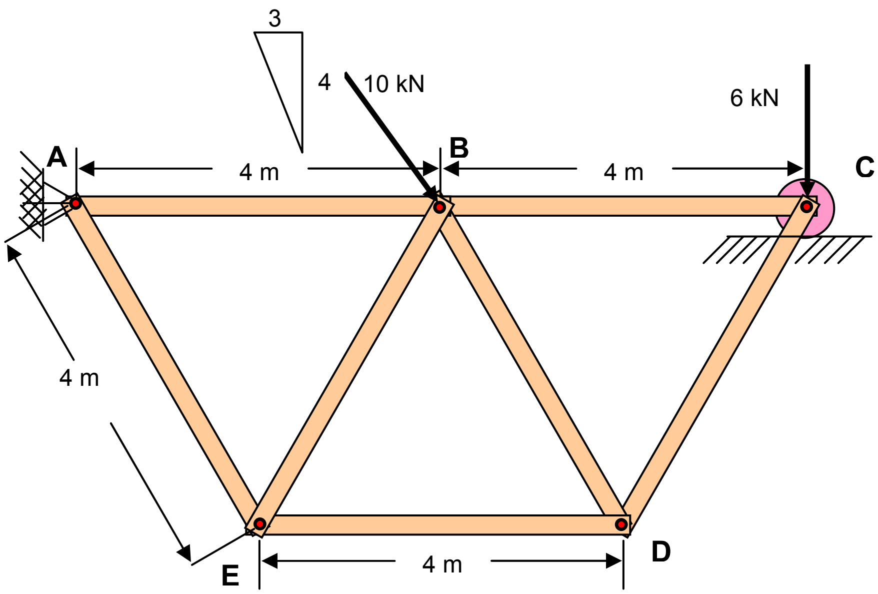
F_{AE} = 1000 lb. (Compresión)

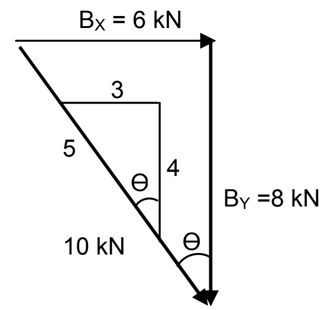
F_{ED} = 1000 lb. (Compresión)

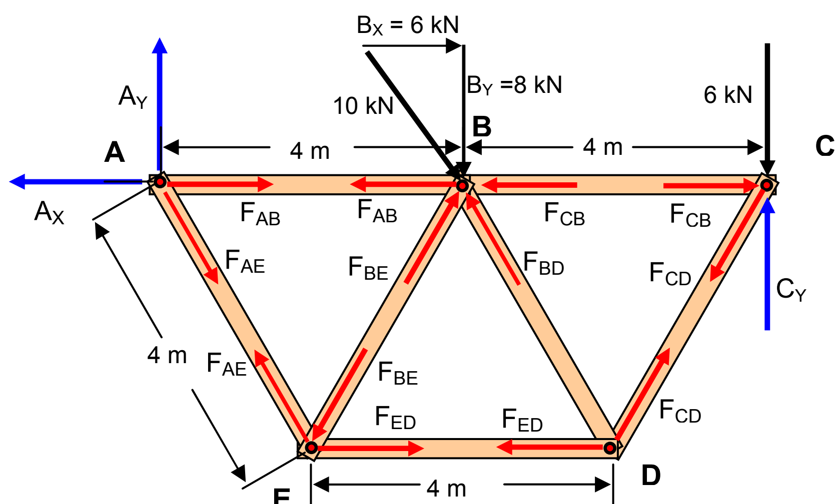
F_{EB} = 0

F_{BC} = 2000 lb. (tracción)

Problema 4.5 Estática Meriam edición tres;
Hallar la fuerza en cada miembro de la armadura cargada. Influye la carga de 6 kN en los resultados.







$\Sigma M_A = 0$

$+ \quad - B_Y (4) + C_Y (4 + 4) - 6 (4 + 4) = 0$

$-\cancel{8} (4) + C_Y (\cancel{8}) - 6 (\cancel{8}) = 0$

$- 4 + C_Y - 6 = 0$

$C_Y - 10 = 0$

$C_Y = 10$ KN

$\Sigma F_X = 0$

$B_X - A_X = 0$ PERO: $B_X = 6$ KN

$B_X = A_X$

$A_X = 6$ KN

$$\frac{B_X}{3} = \frac{10}{5} = \frac{B_Y}{4}$$

Hallar B_X

$$\frac{B_X}{3} = 2$$

$B_X = 3 (2) = 6$ KN

$B_X = 6$ KN

Hallar B_Y

$$\frac{B_Y}{4} = 2$$

$B_Y = 4 (2) = 6$ KN

$B_Y = 8$ KN

$\Sigma M_C = 0$

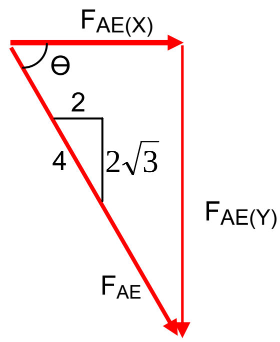
$+ \quad - A_Y (4 + 4) + B_Y (4) = 0$ PERO: **$B_Y = 8$ KN**

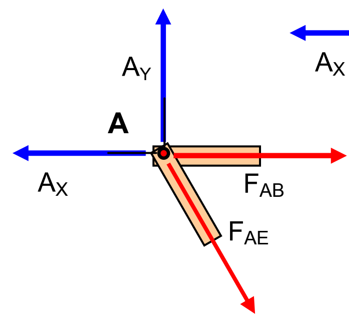
$- A_Y (\cancel{8}) + \cancel{8} (4) = 0$

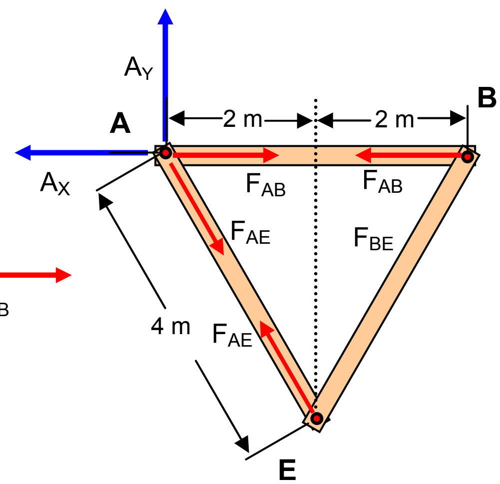
$- A_Y + 4 = 0$

$A_Y = 4$ kN

NUDO A







$$\text{sen }\theta = \frac{F_{AE(Y)}}{F_{AE}}$$

$$\text{sen }\theta = \frac{2\sqrt{3}}{4} = \frac{\sqrt{3}}{2}$$

$F_{AE(Y)} = \text{sen } \Theta \ F_{AE}$

$$F_{AE(Y)} = \frac{\sqrt{3}}{2} F_{AE}$$

$$\cos\theta = \frac{F_{AE(X)}}{F_{AE}}$$

$$\cos\theta = \frac{2}{4} = \frac{1}{2}$$

$F_{AE(X)} = \cos \Theta \ F_{AE}$

$$F_{AE(X)} = \frac{1}{2} F_{AE}$$

$\Sigma F_Y = 0$
$A_Y - F_{AE\,(Y)} = 0$

PERO:
$A_Y = 4$ kN

$F_{AE\,(Y)} = A_Y$

$F_{AE\,(Y)} = 4$ kN

$\Sigma F_X = 0$

$F_{AE(X)} - A_X + F_{AB} = 0$

PERO: $A_X = 6$ KN

$F_{AE(X)} + F_{AB} = A_X$

$F_{AE(X)} + F_{AB} = 6$

$$\frac{1}{2} F_{AE} + F_{AB} = 6 \quad \text{(ECUACION 1)}$$

$F_{AE(Y)} = \text{sen } \Theta \ F_{AE}$

$$F_{AE(Y)} = \frac{\sqrt{3}}{2} F_{AE}$$

$$F_{AE} = \frac{2}{\sqrt{3}} F_{AE(Y)}$$

PERO: $F_{AE\,(Y)} = 4$ Kn

$$F_{AE} = \frac{2}{\sqrt{3}}(4) = 4{,}618 \text{ kN}$$

$F_{AE} = 4{,}618$ KN (tensión)

$$\frac{1}{2} F_{AE} + F_{AB} = 6 \quad \text{(ECUACION 1)}$$

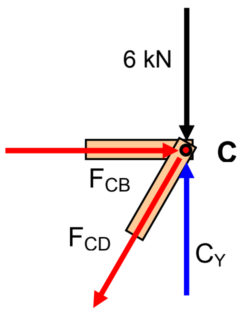
PERO: $F_{AE} = 4{,}618$ KN

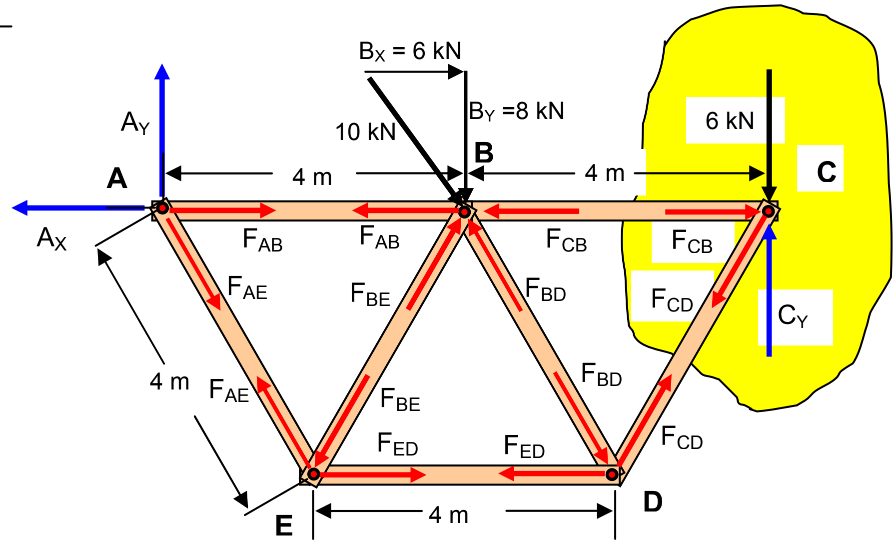
$$F_{AB} = 6 - \frac{1}{2} F_{AE}$$

$$F_{AB} = 6 - \frac{1}{2}(4{,}618) = 6 - 2{,}309 = 3{,}691 \text{ kN}$$

F_{AB} = 3,691 KN (tensión)

NUDO C





$\Sigma F_Y = 0$

$C_Y - 6 - F_{CD\,(Y)} = 0$

PERO:

$C_Y = 10$ kN

$10 - 6 - F_{CD\,(Y)} = 0$

$4 - F_{CD\,(Y)} = 0$

$F_{CD\,(Y)} = 4$ KN

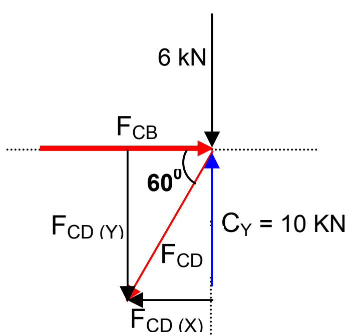
$$\operatorname{sen} 60 = \frac{F_{CD(Y)}}{F_{CD}}$$

$F_{CD\,(Y)} = F_{CD} \operatorname{sen} 60$

$$F_{CD} = \frac{F_{CD(Y)}}{\operatorname{sen} 60} = \frac{4}{0{,}866} = 4{,}618 \text{ kN}$$

F_{CD} = 4,618 KN (tensión)

$\Sigma F_X = 0$



$F_{CB} - F_{CD(X)} = 0$

$F_{CB} = F_{CD(X)}$

F_{CB} = 2,309 kN (compresión)

$$\cos 60 = \frac{F_{CD(x)}}{F_{CD}}$$

$F_{CD\,(X)} = F_{CD} \cos 60$

PERO:

F_{CD} = 4,618 KN (tensión)

$F_{CD\,(X)} = 4{,}618\,(0{,}5) = 2{,}309$ kN

NUDO B

$\Sigma F_X = 0$
$6 - F_{AB} - F_{CB} + F_{BE(X)} - F_{BD(X)} = 0$

PERO:
$F_{AB} = 3{,}691$ KN
$F_{CB} = 2{,}309$ kN

$\cancel{6} - \cancel{3{,}691} - \cancel{2{,}309} + F_{BE(X)} - F_{BD(X)} = 0$

$F_{BE(X)} - F_{BD(X)} = 0$

$F_{BE} \cos 60 - F_{BD} \cos 60 = 0$

$0{,}5\ F_{BE} - 0{,}5\ F_{BD} = 0$ (ECUACION 1)

$\Sigma F_Y = 0$
$F_{BE\,(Y)} + F_{BD\,(Y)} - 8 = 0$

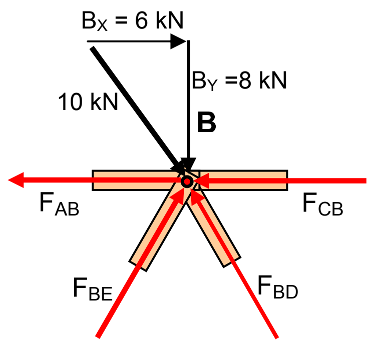
$F_{BE\,(Y)} + F_{BD\,(Y)} = 8$

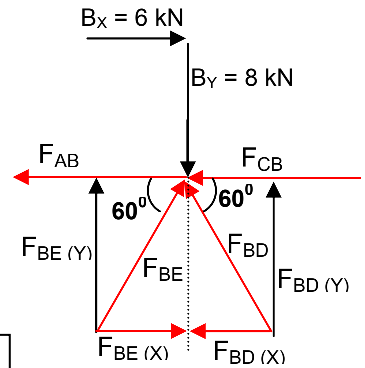
F_{BE} sen 60 + F_{BD} sen 60 = 8

$0{,}866\ F_{BE} + 0{,}866\ F_{BD} = 8$ (ECUACION 2)

Resolver las ecuaciones 1 y 2

$0{,}5\ F_{BE} - 0{,}5\ F_{BD} = 0$ (0,866)
$0{,}866\ F_{BE} + 0{,}866\ F_{BD} = 8$ (0,5)





$$\text{sen } 60 = \frac{F_{BE(Y)}}{F_{BE}}$$
$F_{BE(Y)} = F_{BE}$ sen 60

$$\cos 60 = \frac{F_{BE(x)}}{F_{BE}}$$
$F_{BE(X)} = F_{BE} \cos 60$

$$\text{sen } 60 = \frac{F_{BD(Y)}}{F_{BD}}$$
$F_{BD(Y)} = F_{BD}$ sen 60

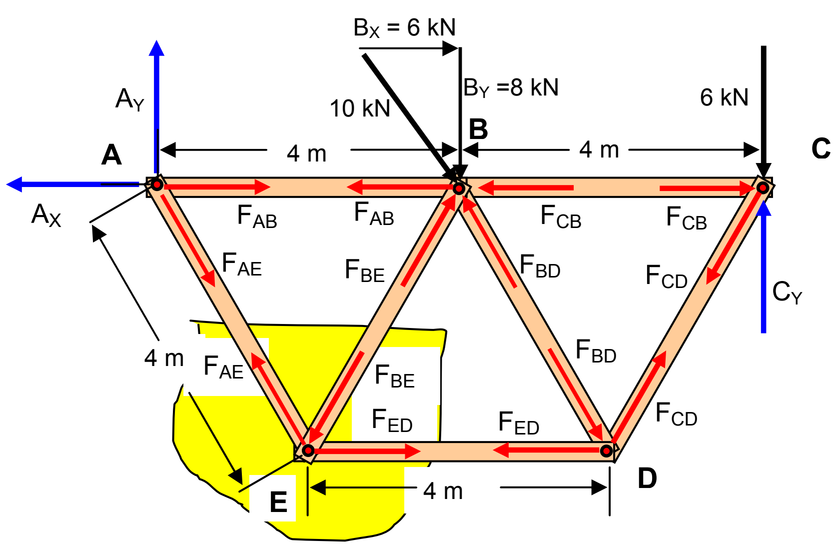
$$\cos 60 = \frac{F_{BD(x)}}{F_{BD}}$$
$F_{BD(X)} = F_{BD} \cos 60$

$0{,}433\ F_{BE} - \cancel{0{,}433\ F_{BD}} = 0$
$0{,}433\ F_{BE} + \cancel{0{,}433\ F_{BD}} = 4$

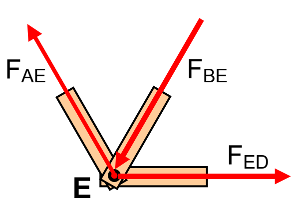
$0{,}866\ F_{BE} = 4$

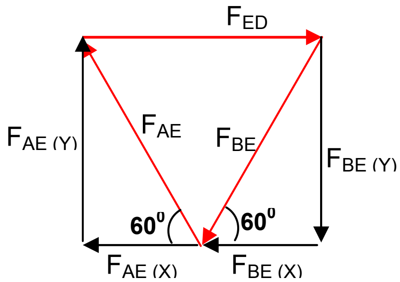
$$F_{BE} = \frac{4}{0{,}866} 4{,}618 \text{ KN}$$

F_{BE} = 4,618 kN (compresion)



NUDO E





$$\text{sen } 60 = \frac{F_{AE(Y)}}{F_{AE}}$$

$F_{AE(Y)} = F_{AE}$ sen 60

$$\cos 60 = \frac{F_{AE(x)}}{F_{AE}}$$

$F_{AE(X)} = F_{AE} \cos 60$

$$\text{sen } 60 = \frac{F_{BE(Y)}}{F_{BE}}$$

$F_{BE(Y)} = F_{BE}$ sen 60

$$\cos 60 = \frac{F_{BE(x)}}{F_{BE}}$$

$F_{BE(X)} = F_{BE} \cos 60$

$\Sigma F_X = 0$

$F_{ED} - F_{AE\ (X)} - F_{BE\ (X)} = 0$

$F_{ED} - F_{AE} \cos 60 - F_{BE} \cos 60 = 0$

PERO:
F_{BE} = 4,618 kN
F_{AE} = 4,618 KN

$F_{ED} = F_{AE} \cos 60 + F_{BE} \cos 60$

F_{ED} = 4,618 (0,5) + 4,618 (0,5)

F_{ED} = 2,309 + 2,309 = 4,618 KN (Tension)

F_{ED} = 4,618 KN (Tension)

C_Y = 10 KN A_Y = 4 kN A_X = 6 KN

F_{AE} = 4,618 KN (tensión)

F_{AB} = 3,691 KN (tensión)

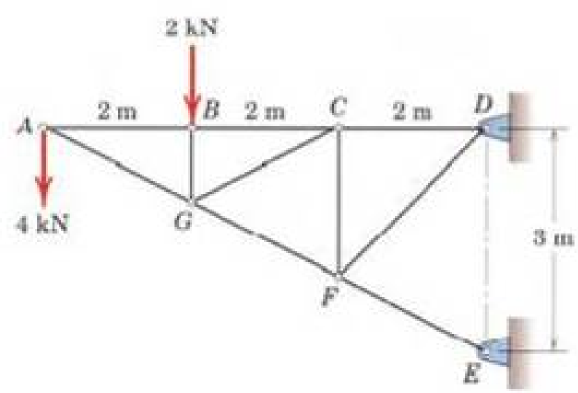
F_{CD} = 4,618 KN (tensión)

F_{CB} = 2,309 kN (compresion)

F_{BE} = 4,618 kN (compresion)

F_{ED} = 4,618 KN (Tension)

Problema 4.7 Estática Meriam edición tres; Problema 4.12 Estática Meriam edición cinco
Calcular las fuerzas en los miembros CG y CF de la armadura representada



$\Sigma M_E = 0$

+ 4 (2 + 2 + 2) + 2 (2 + 2) – D_X (3) = 0

4 (6) + 2 (4) – D_X (3) = 0

24 + 8 – 3 D_X = 0

32 – 3 D_X = 0

$\Sigma F_X = 0$
$D_X - E_X = 0$

$E_X = D_X$

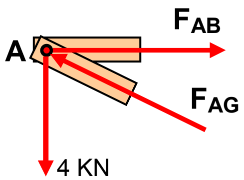
E_X =10,666 KN

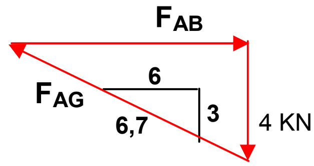
$3\,D_X = 32$

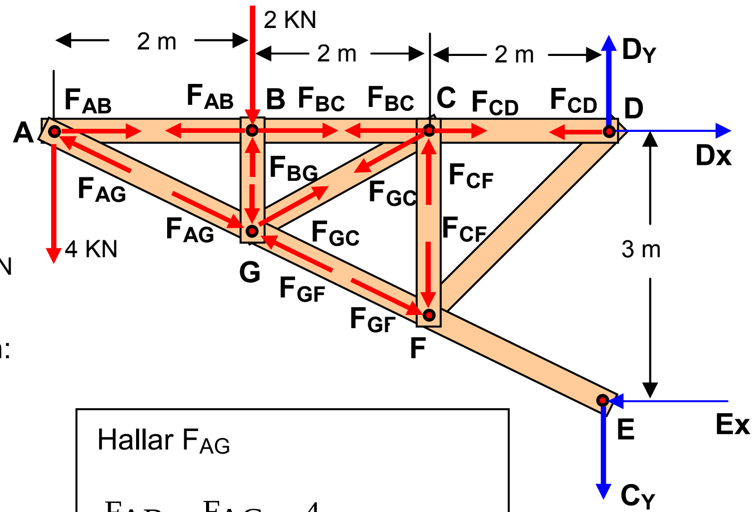
$$D_X = \frac{32}{3} = 10{,}666\ \text{KN}$$

D_X = 10,666 KN

NUDO A







Las ecuaciones de equilibrio para la junta A son:

$$\frac{F_{AB}}{6} = \frac{F_{AG}}{6{,}7} = \frac{4}{3}$$

Hallar F_{AB}

$$\frac{F_{AB}}{6} = \frac{4}{3}$$

$$F_{AB} = \frac{(4)6}{3} = 8\ \text{KN}$$

F_{AB} = 8 KN (tensión)

Hallar F_{AG}

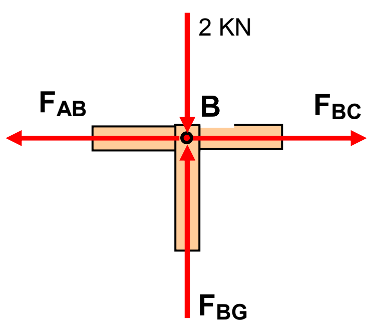
$$\frac{F_{AB}}{6} = \frac{F_{AG}}{6{,}7} = \frac{4}{3}$$

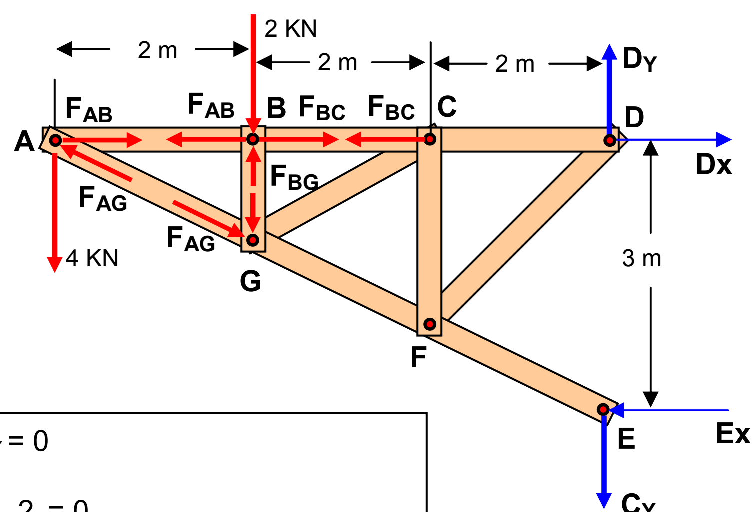
$$\frac{F_{AG}}{6{,}7} = \frac{4}{3}$$

$$F_{AG} = \frac{(6{,}7)4}{3} = 8{,}94\ \text{KN}$$

F_{AG} = 8,94 KN (compresion)

NUDO B





$\sum F_X = 0$

$F_{BC} - F_{AB} = 0$

$F_{BC} = F_{AB}$

PERO: F_{AB} = 8 KN (tensión)

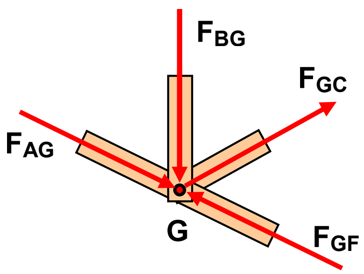
F_{BC} = 8 KN (tensión)

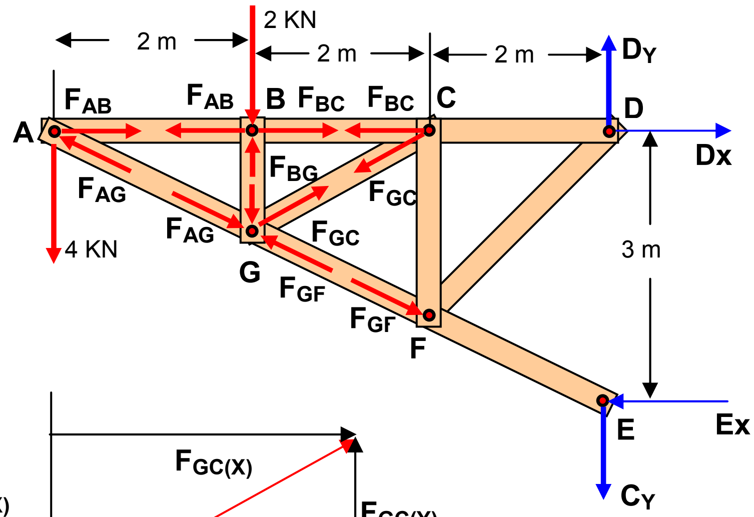
$\sum F_Y = 0$

$F_{BG} - 2 = 0$

F_{BG} = 2 KN (compresión)

NUDO G

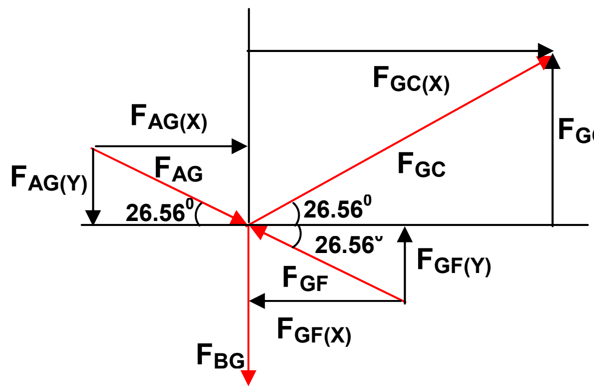




$$\operatorname{tg}\theta = \frac{3}{6} = 0{,}5$$

ϴ = arc tg (0,5)

ϴ = 26,56^0



$$\operatorname{sen} 26{,}56 = \frac{F_{GF(Y)}}{F_{GF}}$$

$F_{GF(Y)} = F_{GF}$ sen 26,56

$$\operatorname{sen} 26{,}56 = \frac{F_{GC(Y)}}{F_{GC}}$$

$F_{GC(Y)} = F_{GC}$ sen 26,56

$$\operatorname{sen} 26{,}56 = \frac{F_{AG(Y)}}{F_{AG}}$$

$F_{AG(Y)} = F_{AG}$ sen 26,56

$\sum F_X = 0$

$F_{GC\,(X)} + F_{AG\,(X)} - F_{GF\,(X)} = 0$

PERO:

$F_{GC\,(X)} = F_{GC}$ cos 26,56

$F_{GF\,(X)} = F_{GF}$ cos 26,56

$F_{AG\,(X)} = F_{AG}$ cos 26,56

F_{AG} = 8,94 KN (compresion)

$F_{AG\,(X)} = F_{AG}$ cos 26,56

$F_{AG\,(X)}$ = (8,94) cos 26,56

$F_{GC\,(X)} + F_{AG\,(X)} - F_{GF\,(X)} = 0$

$F_{GC}\,\cancel{\cos 26{,}56} + (8{,}94)\,\cancel{\cos 26{,}56} - F_{GF}\,\cancel{\cos 26{,}56} = 0$

$$\cos 26{,}56 = \frac{F_{GF(X)}}{F_{GF}}$$

$F_{GF\,(X)} = F_{GF}$ cos 26,56

$$\cos 26{,}56 = \frac{F_{GC(X)}}{F_{GC}}$$

$F_{GC\,(X)} = F_{GC}$ cos 26,56

$$\cos 26{,}56 = \frac{F_{AG(X)}}{F_{AG}}$$

$F_{AG\,(X)} = F_{AG}$ cos 26,56

$F_{GC} + 8,94 - F_{GF} = 0$

$F_{GC} - F_{GF} = - 8,94$ (Ecuación 1)

Resolver las ecuaciones

$F_{GC} - F_{GF} = - 8,94 \quad (-0,4471)$
$0,4471\ F_{GC} + 0,4471\ F_{GF} = 6$

$\cancel{-0,4471\ F_{GC}} + 0,4471\ F_{GF} = 4$
$\cancel{0,4471\ F_{GC}} + 0,4471\ F_{GF} = 6$

$0,4471\ F_{GF} + 0,4471\ F_{GF} = 4 + 6$

$0,8942\ F_{GF} = 10$

$$F_{GF} = \frac{10}{0,8942} = 11,18\ KN$$

F_{GF} = 11,18 KN (compresion)

Reemplazar la ecuación 1

$F_{GC} - F_{GF} = - 8,94$ (Ecuación 1)

Pero: F_{GF} = 11,18 KN

$F_{GC} – 11,18 = - 8,94$

$F_{GC} = 11,18 - 8,94$

F_{GC} = 2,24 KN (tensión)

$\sum F_Y = 0$

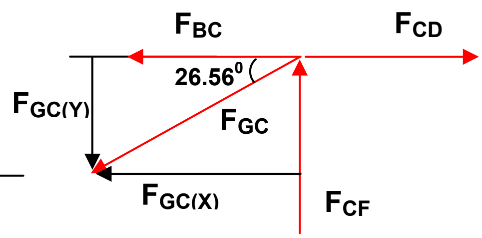
$F_{GC\,(Y)} + F_{GF\,(Y)} - F_{AG\,(Y)} - F_{BG} = 0$

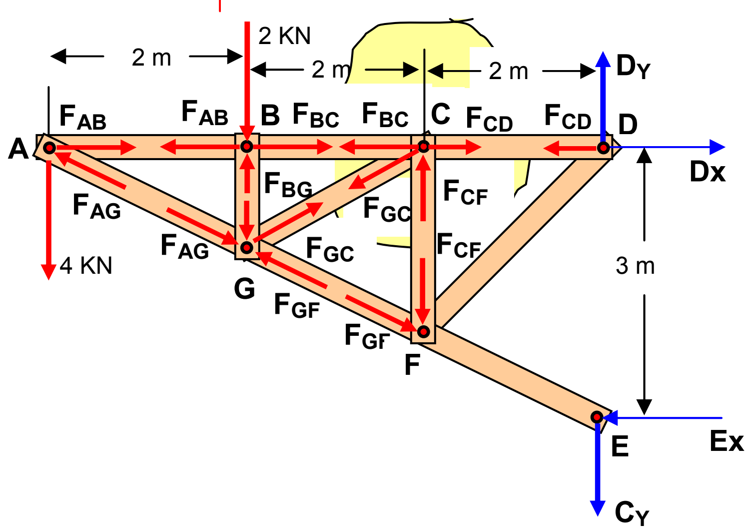
PERO:
$F_{GC(Y)} = F_{GC}$ sen 26,56
$F_{GF(Y)} = F_{GF}$ sen 26,56
F_{BG} = 2 KN (compresión)

$F_{AG(Y)} = F_{AG}$ sen 26,56
F_{AG} = 8,94 KN (compresion)
$F_{AG\,(Y)}$ = (8,94) sen 26,56
$F_{AG\,(Y)}$ = (8,94) (0,4471)
$F_{AG\,(Y)}$ = 4 KN

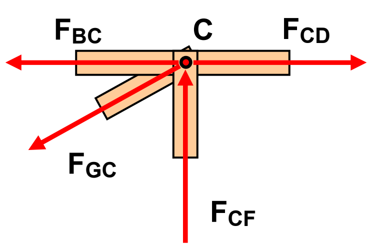
$F_{GC\,(Y)} + F_{GF\,(Y)} - F_{AG\,(Y)} - F_{BG} = 0$
$F_{GC\,(Y)} + F_{GF\,(Y)} - 4 - 2 = 0$
$F_{GC\,(Y)} + F_{GF\,(Y)} - 6 = 0$
$F_{GC\,(Y)} + F_{GF\,(Y)} = 6$

$0,4471\ F_{GC} + 0,4471\ F_{GF} = 6$
(Ecuación 2)





NUDO C



PERO:
F_{BC} = 8 KN
F_{GC} = 2,24 KN

$$\cos 26,56 = \frac{F_{GC(X)}}{F_{GC}}$$

$F_{GC\,(X)} = F_{GC}$ cos 26,56
$F_{GC\,(X)}$ = (2,24) cos 26,56
$F_{GC\,(X)}$ = (2,24) 0,8944

$F_{GC\,(X)} = 2\ KN$

$\sum F_X = 0$

$F_{CD} - F_{BC} - F_{GC\,(X)} = 0$

PERO:

$F_{BC} = 8\ KN$

$F_{GC\,(X)} = 2\ KN$

$F_{CD} - F_{BC} - F_{GC\,(X)} = 0$

$F_{CD} - 8 - 2 = 0$

$F_{CD} - 10 = 0$

$F_{CD} = 10\ kN$ (tensión)

$$\text{sen } 26{,}56 = \frac{F_{GC(Y)}}{F_{GC}}$$

$F_{GC\,(Y)} = F_{GC}$ sen 26,56

$F_{GC\,(Y)} = (2{,}24)$ sen 26,56

$F_{GC\,(Y)} = (2{,}24)\ 0{,}4471$

$F_{GC\,(Y)} = 1\ KN$

$\sum F_Y = 0$

$F_{CF} - F_{GC\,(Y)} = 0$

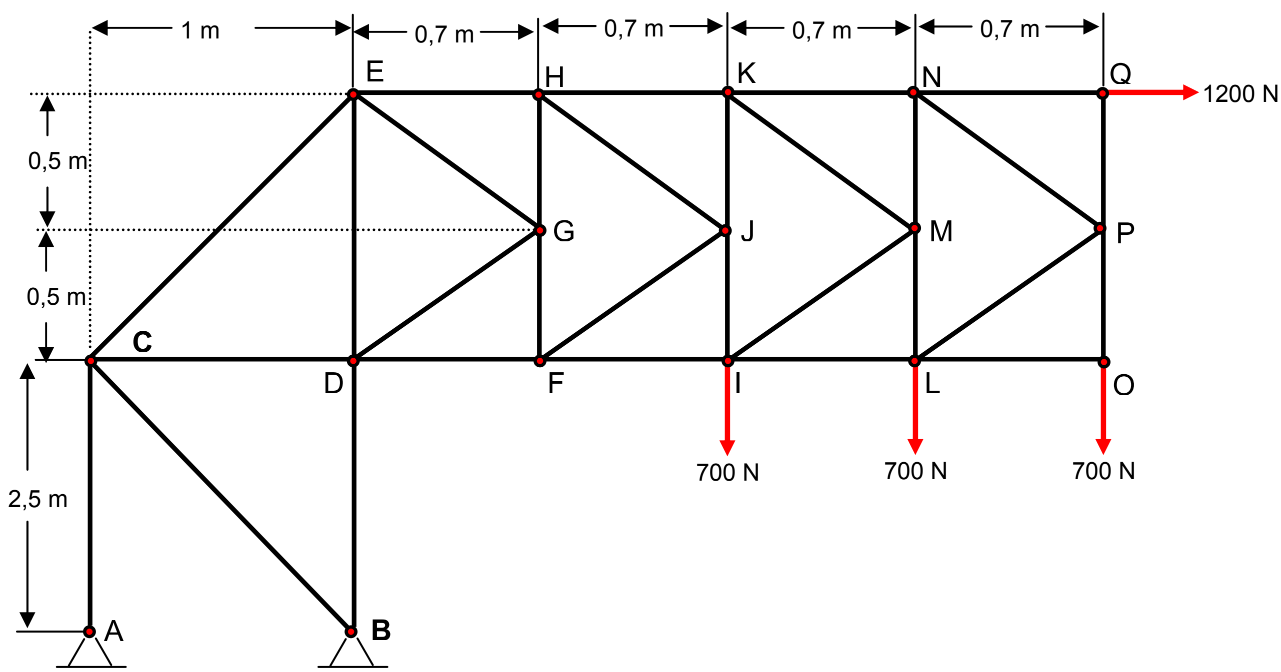
$F_{CF} = F_{GC\,(Y)}$

PERO:

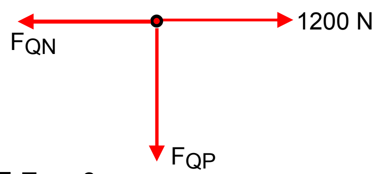
$F_{GC\,(Y)} = 1\ KN$

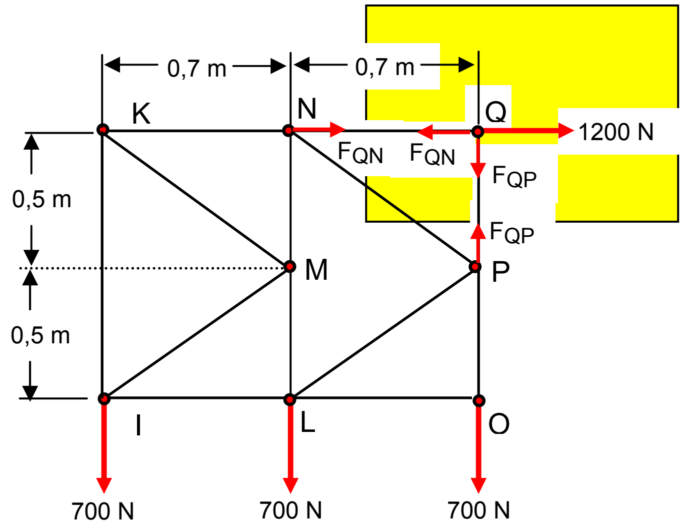
$F_{CF} = 1\ KN$ (compresión)

Determinar la fuerza que soporta el elemento KN de la armadura.



NUDO Q





$\sum F_X = 0$

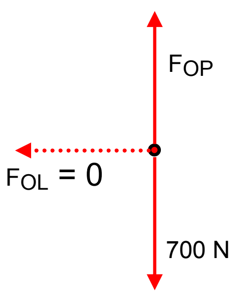
$1200 - F_{QN} = 0$

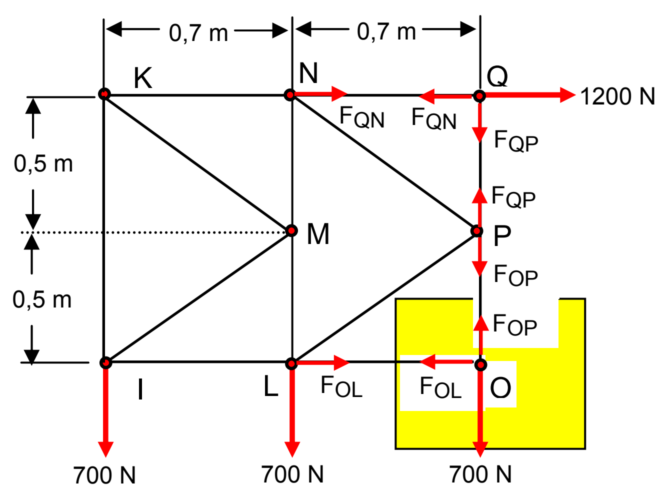
F_{QN} = 1200 N (tension)

$\sum F_Y = 0$

F_{QP} = 0

NUDO O





$\sum F_X = 0$

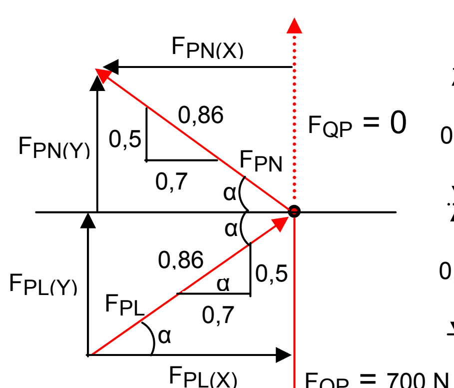
F_{OL} = 0

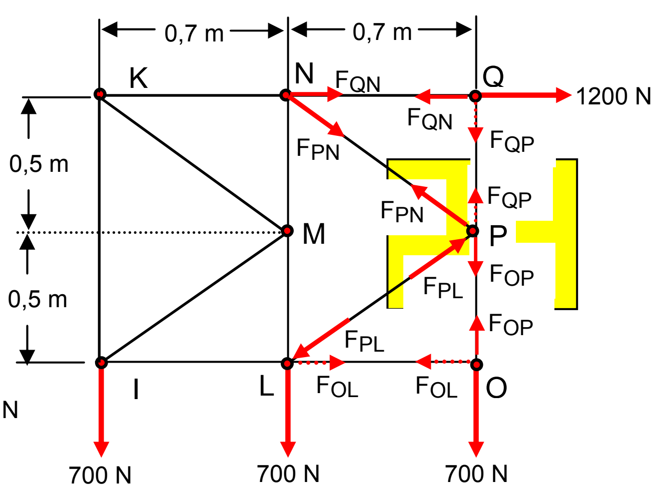
$\sum F_Y = 0$

$F_{OP} - 700 = 0$

F_{OP} = 700 N (tensión)

NUDO P





$$\operatorname{sen}\alpha = \frac{0,5}{0,86} = 0,581$$

$$\cos\alpha = \frac{0,7}{0,86} = 0,813$$

$$\cos\alpha = \frac{F_{PN}(X)}{F_{PN}} = 0,813$$

$F_{PN(X)} = 0{,}813\ F_{PN}$

$$\text{sen}\ \alpha = \frac{F_{PN(Y)}}{F_{PN}} = 0{,}581$$

$F_{PN(Y)} = 0{,}581\ F_{PN}$

$$\cos \alpha = \frac{F_{PL(X)}}{F_{PL}} = 0{,}813$$

$F_{PL(X)} = 0{,}813\ F_{PL}$

$$\text{sen}\ \alpha = \frac{F_{PL(Y)}}{F_{PL}} = 0{,}581$$

$F_{PL(Y)} = 0{,}581\ F_{PL}$

$\sum F_X = 0$

$F_{PL(X)} - F_{PN(X)} = 0$

$\cancel{0{,}813}\ F_{PL} - \cancel{0{,}813}\ F_{PN} = 0$

cancelando términos semejantes

$F_{PL} - F_{PN} = 0$ (ECUACION 1)

$\sum F_Y = 0$

$F_{QP} + F_{PN(Y)} + F_{PL(Y)} - F_{OP} = 0$

PERO:
$F_{QP} = 0$ KN
$F_{OP} = 700$ KN

$F_{PN(Y)} - F_{PL(Y)} - 700 = 0$

$F_{PN(Y)} - F_{PL(Y)} = 700$

$0{,}581\ F_{PN} + 0{,}581\ F_{PL} = 700$ (ECUACION 2)

Resolver las ecuaciones

$F_{PL} - F_{PN} = 0$ (ECUACION 1)

$0{,}581\ F_{PN} + 0{,}581\ F_{PL} = 700$ (ECUACION 2)

$F_{PL} - F_{PN} = 0$ (0,581)

$0{,}581\ F_{PN} + 0{,}581\ F_{PL} = 700$

$0{,}581\ F_{PL} – \cancel{0{,}581\ F_{PN}} = 0$

$\cancel{0{,}581\ F_{PN}} + 0{,}581\ F_{PL} = 700$

---

(2) $0{,}581\ F_{PL} = 700$

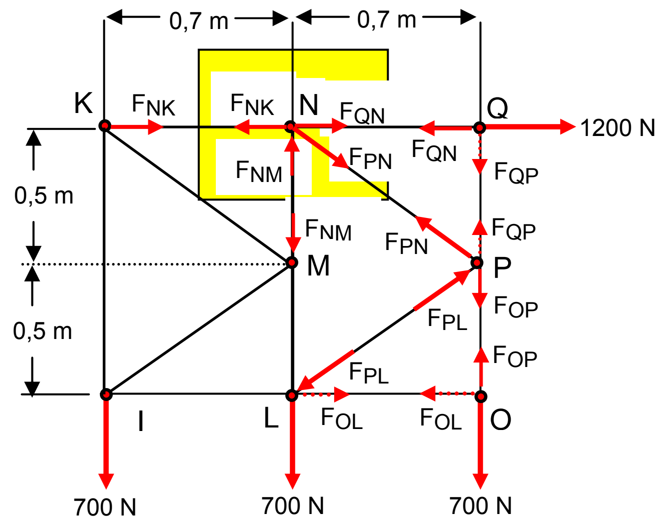
$1{,}162\ F_{PL} = 700$

$$F_{PL} = \frac{700}{1{,}162} = 602{,}4\ \text{N}$$

F_{PL} = 602,4 N (compresión)

$F_{PL} = F_{PN}$ (ECUACION 1)

F_{PN} = 602,4 N (tensión)



NUDO N

Pero: F_{PN} = 602,4 N (tensión)

$$\operatorname{sen} \alpha = \frac{0,5}{0,86} = 0,581$$

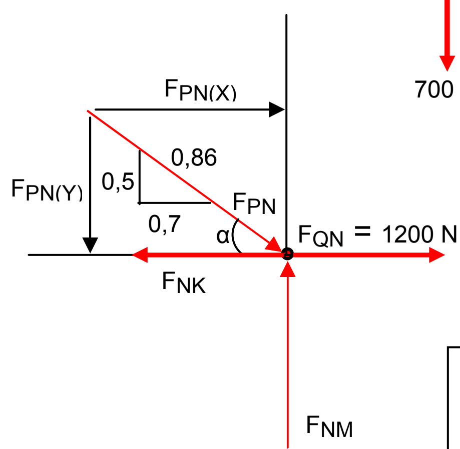
$$\cos \alpha = \frac{0,7}{0,86} = 0,813$$

$$\cos \alpha = \frac{F_{PN(X)}}{F_{PN}} = 0,813$$

$F_{PN(X)} = 0,813\ F_{PN}$

$F_{PN(X)} = 0,813\ (602,4)$

$F_{PN(X)} = 489,75$ N



$$\operatorname{sen} \alpha = \frac{F_{PN(Y)}}{F_{PN}} = 0,581$$

$F_{PN(Y)} = 0,581\ F_{PN}$

$F_{PN(Y)} = 0,581\ (602,4)$

$F_{PN(Y)}$ = 350 N

$\sum F_X = 0$

$F_{QN} + F_{PN(X)} - F_{NK} = 0$

Pero:

F_{QN} = 1200 N

$F_{PN(X)}$ = 489,75 N

$F_{QN} + F_{PN(X)} - F_{NK} = 0$

$1200 + 489,75 - F_{NK} = 0$

$1689,75 - F_{NK} = 0$

F_{NK} = 1689,75 N (tensión)

$\sum F_Y = 0$

$F_{NM} - F_{PN(Y)} = 0$

PERO:

$F_{PN(Y)}$ = 350 N

$F_{NM} = F_{PN(Y)}$

F_{NM} = 350 N (compresión)

F_{QN} = 1200 N (tensión)	**F_{QP} = 0**
F_{OP} = 700 N (tensión)	**F_{OL} = 0**
F_{PL} = 602,4 N (compresión)	**F_{PN} = 602,4 N (tensión)**
F_{NK} = 1689,75 N (tensión)	**F_{NM} = 350 N (compresión)**